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Power Generation

May, 1948

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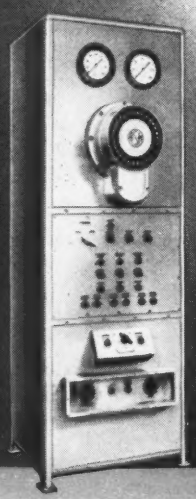
A Feather IN YOUR Cap

Wouldn't it be "a feather in your cap" if you could tell your management:

1. **You could handle all the dust in the plant automatically**
2. **Savings would pay for the complete installation in months**
3. **Every year it would pay big dividends on the investment**

All you need do is have our representative explain the new Automatic Hydrovac System; then you take the amazing facts to management and you get the "feather." We have representatives in most principal cities. Write us. The Allen-Sherman-Hoff Co., 233 South 15th St., Philadelphia 2, Pa.



Automatic Sequence Head, the brain controlling the Automatic Hydrovac. Its reliability is uncanny and absolutely foolproof.

ENGINEERS' PREVIEW

SOME OF THE NAVY'S plans for the building of new types of ships and the conversion of others for different uses were revealed in February by the Navy Department. Among other items, a group of submarines is being streamlined to increase their submerged speed. Several submarines will be equipped with the latest American devices and with many developed by the Germans during World War II. Streamlining of hulls by reducing size of superstructure, removal of deck guns and other topside appurtenances is being carried out on some vessels. The "schnorkel," a breathing tube apparatus developed by the Germans, is being installed on the undersea craft.

★ ★ ★

ANOTHER ELECTRICAL WIZARD for calculating industrial and scientific problems has been built at Columbia University. This is the heat and mass flow analyzer based on a principle first developed by a Dutch engineer, Dr. C. L. Beuken. It is based on the electric analogy method, which means that flow of heat is measured in the same way as electric current. Samples of the material do not have to be used directly; often the only data required are the thermal properties of the materials involved and their size and shape. Unusual applications on which the calculator may be used are detection of a bad tooth by its sensitivity to heat and cold; also computation of the geological age of the earth. The heat and mass flow analyzer laboratory at Columbia has undertaken many problems in heat flow, such as heat transfer in solidification of metals; heat generation of brakes on trains and planes; analysis of heat transfer in finned heat exchangers; solution of problems involving complicated shapes with heat flow in two or three directions, for example, in the production of rubber tires.

DON'T SHOOT THE PIANO PLAYER—or— WHY YOUR ISSUES ARE LATE

PRODUCTION difficulties in the printing industry in Chicago account for the delayed issues of the past few months. The April issue was delayed worst of all. Many of you wrote in to inquire about it. We deeply appreciate your interest and can assure you that we are doing everything possible to get the magazine to you under incredibly difficult conditions.

The production difficulties referred to above produce all the effects of a six-letter word beginning with "s" and rhyming with "Mike". We are not permitted to use the word because, theoretically, there is no such thing. But it certainly feels like one. Anyway, if we were permitted to tell you how we got out this issue and the April issue, we believe you would echo the sentiment displayed in the saloons of the old wild West: "Don't shoot the piano player—he's doing his damndest."

THE FAMOUS Diesel electric power station of the Western New South Wales Electric Power Property, Ltd., in Broken Hill, Australia, now that country's largest Diesel plant, is having its capacity increased to over 40,000 hp by the addition of several new Diesel engines. In 1931 the plant was equipped by Sulzer Bros. of Switzerland with six 2-stroke engines of 3140 hp each. In 1937 the plant was extended by the addition of two engines of 3450 hp and 1200 hp so that the total output was brought up to 23,490 hp. Five additional units have now been ordered from Sulzer Bros. These consist of three 6-cylinder types of the latest crosshead design, with lateral scavenge pumps, each of 4500 hp; two 4-cylinder trunk piston engines, developing 1200 hp each; and another 5-cylinder engine of the same type developing 1530 hp. The 4-cylinder engines are designed for driving air compressors while the others are directly connected to a-c generators. The new engines thus have a nominal total rating of 17,430 hp.

★ ★ ★

CHROMATED PROTEIN COATINGS offering a convenient, inexpensive method of protecting metals—especially zinc, iron, brass and aluminum—during outdoor storage in mildly corrosive atmospheres, have been developed by Abner Brenner, Grace Riddell and Robert Seegmiller of the National Bureau of Standards. The metallic surface to be coated is first dipped in casein, albumin, or gelatin; the resultant film is then impregnated with chromate, which both hardens the film and inhibits corrosion. The protective value of such films is claimed to be somewhat better than that afforded by chemical surface treatment and much superior to that of corrosion-inhibited oils and waxes. Full details of the process are given by Brenner, Riddell and Seegmiller in a paper, entitled Chromated Protein Films for the Protection of Metals, *Journal Electrochemical Society*, March, 1948, and are reported on more fully in *Technical Report No. 1208*, obtainable from National Bureau of Standards, Washington 25, D. C., without charge.

★ ★ ★

UNLESS American industry mechanizes and modernizes faster than it is doing today, our national economy may stagnate, asserts William J. Kelly, president of the Machinery and Allied Products Institute. Since 1930, he points out, production facilities in America have worn out faster than they have been replaced. Many national policies, he claims, are incompatible with the maintenance of a dynamic and expanding economy. Until we reverse these practices, America will have alarming symptoms of a technological decline, similar to that which has overtaken England and France, believes Mr. Kelly. In the United States, he says, as in England, security and stability are being sought at the expense of technological advancement. The American worker produces about three times as much as the British worker, because of the superior equipment he has. In large segments of British industry, more than half the equipment in use today was installed before the first World War.

NATURAL GAS from Texas fields is now flowing into Philadelphia, Pa., 1280 miles away. The gas, transmitted through the Big Inch pipeline, is expected to reach the rate of 4,300,000 cu ft a day. The Federal Power Commission authorized the flow for a 36-day emergency period and it is expected to enable the Philadelphia Gas Works to reduce its use of fuel oil by 43,000 gallons daily. Further technical details on the methods and equipment used in converting the Big Inch and Little Big Inch pipelines to transmit gas instead of oil will be given in these pages soon.

★ ★ ★

DEVELOPMENT OF A new type of marine Diesel engine, half the size and less than half the weight of engines in general use, has recently been announced. A model of this engine has been completed in Holland by Werkspoor, one of the largest manufacturers of equipment in Holland.

The new Diesel engine was invented by J. G. Lugt, a marine engineer, in 1943 during the German occupation of the Netherlands and without the knowledge of the Nazis. Immediately upon Holland's liberation, Werkspoor initiated large-scale research work on this invention and the first experimental engine is now ready.

The engine is a 1200-hp two-cylinder unit. It is also stated that it can be made with 3, 4 or more cylinders because each is an independent unit. A 6-cylinder Diesel of this type would have a capacity of 3600 hp, the same as an 8-cylinder, 4-stroke engine now being manufactured by Werkspoor. It is claimed to be much quieter and weighs only 140 tons against 315 tons for the other type.

★ ★ ★

METHOD OF TESTING AIR of machine shops to detect the presence of beryllium in quantities as small as 0.000000001 lb has been perfected by General Electric Co.

★ ★ ★

PRODUCTION OF synthetic detergents, the soapless soaps, will soon reach 750,000,000 lb annually and predictions of a 3,000,000,000 lb production within 15 years have been made. They have many applications in addition to those in water. For example, according to the *Industrial Bulletin,* in the cold rolling of steel, an oil emulsion is applied to the surface of the sheet steel to reduce friction and increase the speed at which the mill operates. Again, accumulation of coal dust in the air of mines is being treated by spraying a fine mist of detergent solution into the mine atmosphere to dampen and ground suspended particles. Concrete with air entrapped in minute air pockets is more resistant to cracking and scaling and some detergents are found to be efficient as air entraining agents in concrete. Two large cities are washing highways with detergents to remove oil film in one flushing operation and leave a skid-free surface. Cleaning of automobiles, buses and trucks with detergents is now well established. In food preparation, synthetics with lye solutions help to peel fruit prior to canning. In small concentrations, detergents may clean vegetables without leaving a taste. Finally, at least one detergent has been employed in commercial cake mixes to produce a light, fluffy product.

SLOWLY, but none the less surely, the general conception of the semi-outdoor design of power plant is winning wider acceptance.

In recent years, designers goaded by the necessity for combatting ever-increasing power plant construction costs have looked more and more frequently at this idea. Even a 2 or 3 per cent saving in total first cost of a plant, a very conservative figure, is today much more attractive than it used to be. It is significant that two of the very recent designs—that for the Sewaren Station in New Jersey and that for the O. H. Hutchings Station in Ohio—are to be semi-outdoor stations, with a considerable portion of the boilers and auxiliaries set outdoors, but with the turbine generators and control equipment inside a building. While the climate in which these two plants are located cannot be considered the mildest in the country, on the other hand, it is not the most severe. These two plant locations have their share of bad weather at certain times of the year but so has the semi-outdoor mercury plant at Schenectady. The present necessity, if it leads designers to nothing more than further careful analysis of both sides of the outdoor plant problem, may prove a blessing in disguise.

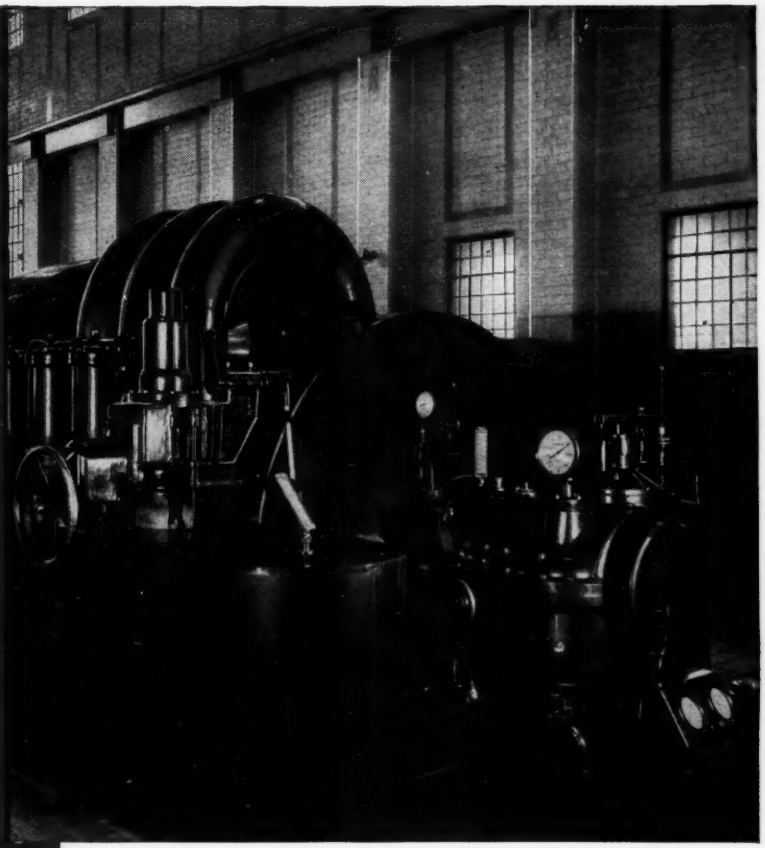
★ ★ ★

ELECTRONIC VULCANIZATION of rubber has been adopted as standard production procedure by the B. F. Goodrich Co. for certain types of extruded products, following several years of experimentation. Such articles as tubing, strip and channel stock and rubber thread are being given the super-quick electronic cure. This process eliminates much product handling during manufacture, speeds the process and gives product quality advantages. In the process, energy waves create internal friction by agitating molecules in the rubber, generating temperatures of about 300 F. In some products, the actual curing time is reduced from an hour and a half to two minutes.

★ ★ ★

NEW APPROACH to the problem of engineering education was recently proposed by Dean Thorndike Saville of New York University in his recent annual report. A general four-year course would be established to be taken by substantially all engineering students. It would be uniform, or nearly so, for the first three years and would lead to the degree of Bachelor of Engineering. The first three years would have all the basic sciences and fundamental engineering subjects now offered but would add courses in history, public affairs and economics. The highly specialized subjects now on the increase in several sophomore and junior year curricula would be omitted. The senior year would have a considerable number of electives designed for those who expect to end their technical education in four years. These electives also should be designed for those who are selected to take a fifth year of specialized programs leading to degrees in various specialized fields. Possibly half of the total completing the work for the Bachelor of Engineering degree might wish to prepare for industrial and governmental jobs outside of strictly professional engineering, or to pursue graduate work in other fields. They would be better prepared for these fields because of their fundamental engineering course. A corollary would be the restoration of the master's degree on a truly post-graduate level. Under the new plan students would be given careful guidance in selection of courses.

Protect The Heart of Your Turbine



Assure instantly responsive governor action by keeping the lubricating system free of rust and varnish. Use *Texaco Regal Oils (R & O).*

TEXACO *Regal Oils* (*R & O*) give both governor and the entire turbine system an extra margin of safety. They are, in fact, the world-famous Texaco Regal Oils *improved* with rust and oxidation inhibitors and processed to prevent foaming. They keep lubricating systems clean and bearing temperatures normal . . . give extra long service life.

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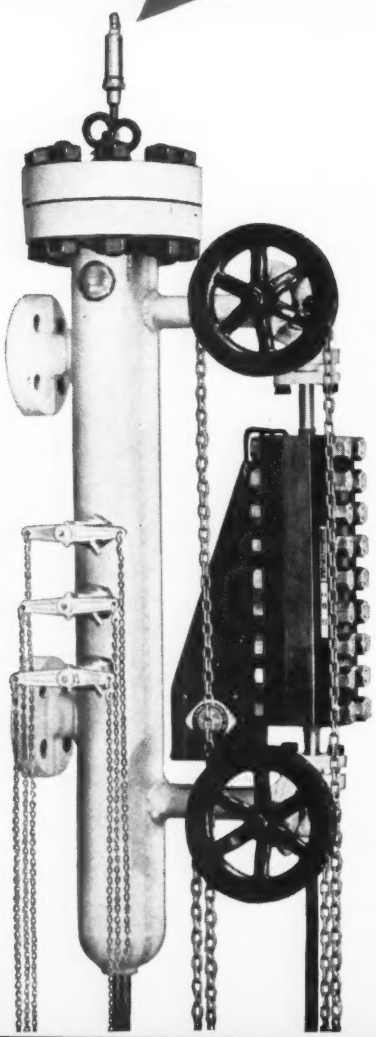
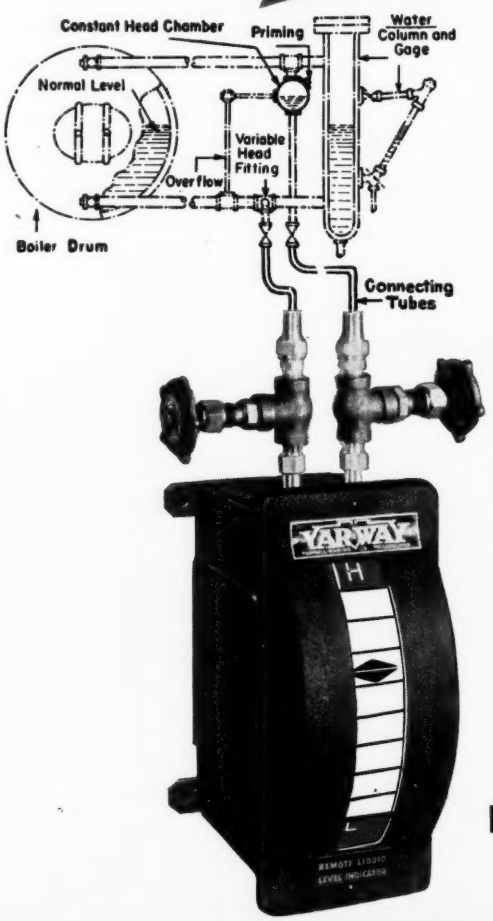
YARWAY
WATER COLUMNS
AND GAGES



A

YARWAY
REMOTE BOILER
WATER LEVEL
INDICATORS



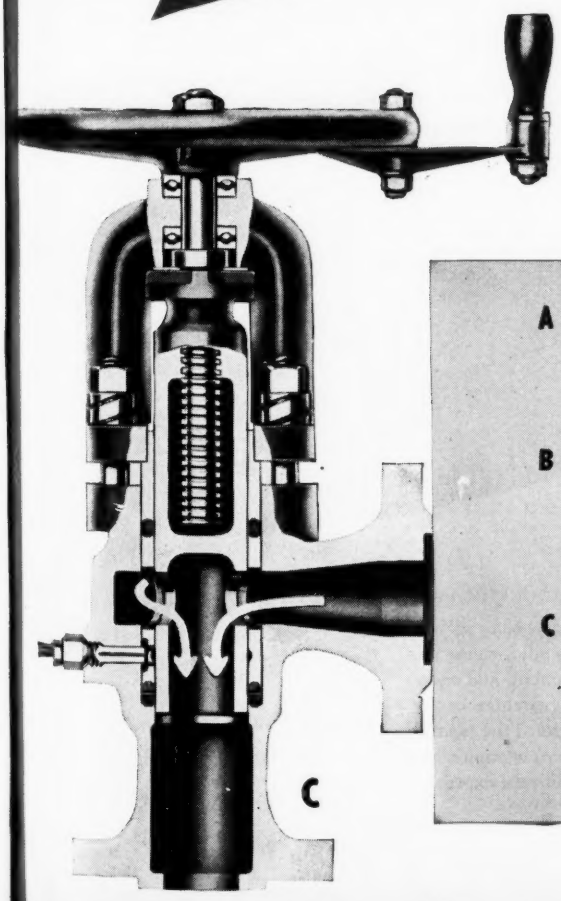
B

YARWAY

RESPONSIBILITY

all 3 FROM YARWAY

YARWAY BLOW-OFF VALVES



Power plant engineers may simplify responsibility by insisting that all three of these important boiler trim items be Yarway.

Why, you ask?

First, responsibility for the satisfactory performance of all three is centered in one company.

Second, Yarway's extensive service organization, with branches in principal cities in the United States and Canada, is conveniently at your service.

Third, each product has an outstanding feature—an *engineering reason,* laboratory-tested and field-proved for better performance.

For more complete facts on these and other products in the Yarway line of steam plant equipment, write for Yarway's all-products Catalog G-1306.

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A — Yarway Hi-Lo Alarm *Floatless* Water Column with patented Yarway Flat Glass Gage featuring a "floating assembly" that practically eliminates glass breakage. For pressures from 400 to 2500 psi. Other Yarway Columns and Gages for lower pressures. Write for Yarway Bulletin WG-1811

B — Yarway Remote Boiler Water Level Indicator that brings overhead readings right down to eye level, on instrument panel or other convenient place. Always accurate because it's operated by the boiler water itself. Action is instant, constant. *No stuffing boxes.* Moderate in price. Easy to install. For all pressures to 1500 psi. Write for Yarway Bulletin WG-1822

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*GUARANTEE

"We guarantee that Nonpareil Turbine Oil, Medium and Heavy, will last as long as your turbine where the lubrication system is thoroughly cleaned before this oil is put into use and where Nonpareil Turbine Oil, Medium or Heavy only, is used for replenishment, and where the temperature of the oil from the bearings is kept below 170° F. This guarantee has no time limit. If at any time, when the oil is operating under the above conditions, the neutralization number should rise higher than the extremely low limit of 0.15 when determined by A.S.T.M. Method D 188-27 T, we will cheerfully replace the oil without additional expense."

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5 safeguards against outages

NONPAREIL TURBINE OIL

Under varying service conditions, one or all of these turbine oil qualities can bring added dependability to your turbine operation.

1. ***Nonpareil does not form asphaltic deposits.*** Delicate governor parts, oil lines, and bearings stay clean because the refining process removes from the oil all asphaltene-forming hydrocarbons.

2. ***Nonpareil does not increase in acidity*** above 0.15 mg.KOH/gm no matter how long it is left in a turbine. This is *guaranteed** in writing.

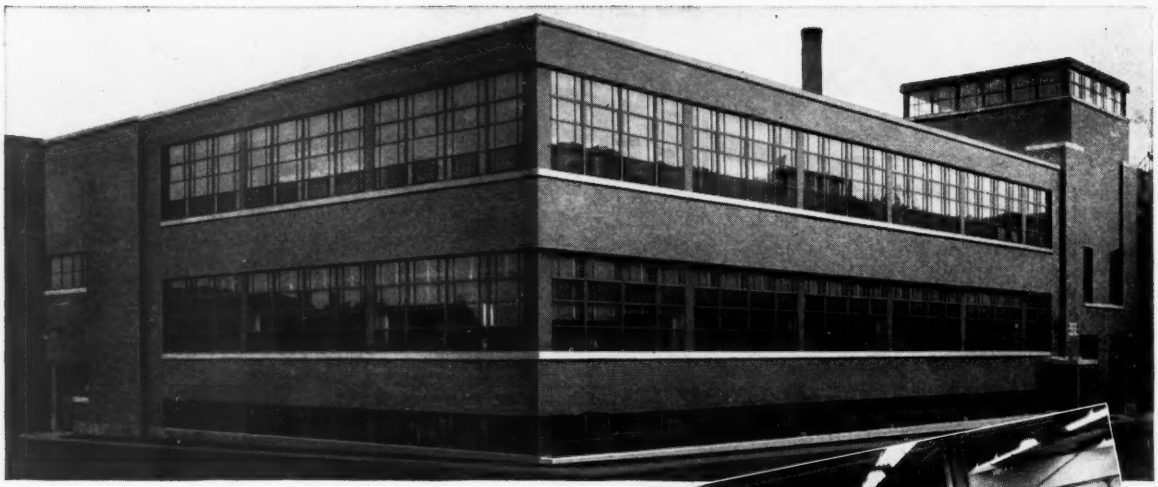
3. ***Nonpareil does not need treating, resting or replacing.*** There are no interruptions to turbine operation because of oil deterioration.

4. ***Nonpareil resists foaming.*** It contains an anti-foam additive which prevents oil overflow, eliminating a potential fire hazard or loss of oil.

5. ***Nonpareil contains a corrosion inhibitor*** and passes A.S.T.M. D-665-46T test for corrosion resistance.

20 years of operation prove that Nonpareil-lubricated turbines require no outage time for oil system maintenance. You can check this fact with nearby users of Nonpareil. A Standard Oil Lubrication Engineer will give you their names and locations. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois for the nearest Engineer.

IANA STANDARD OIL COMPANY (INDIANA) STANDARD



Research

Starting in 1887 with the fundamental question — "what makes packing pack?" — Garlock has extended its research from year to year until the newly constructed building shown above is now required to house Garlock's research activities. Garlock products are developed, improved and refined in these completely modern chemical, physical and rubber-compounding laboratories; thoroughly tested in the fully equipped test department and processed in the pilot plant before ever reaching the production department. This *Quality Control* is your assurance of uniformly high quality in every product sold under the Garlock name.

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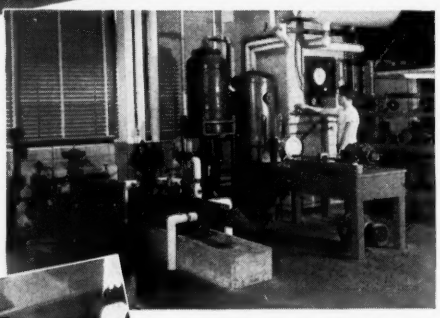
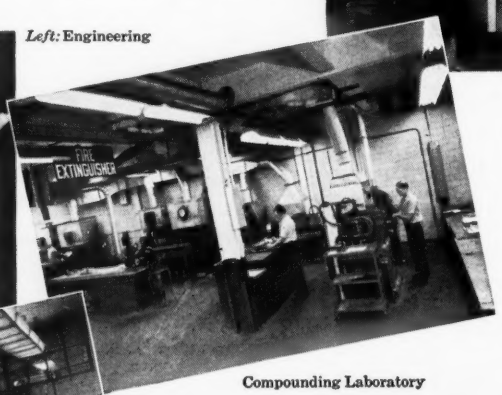
Testing Laboratories general view

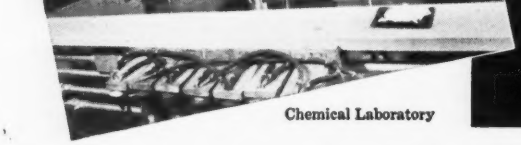


Another section of Testing Laboratories

Left: Engineering

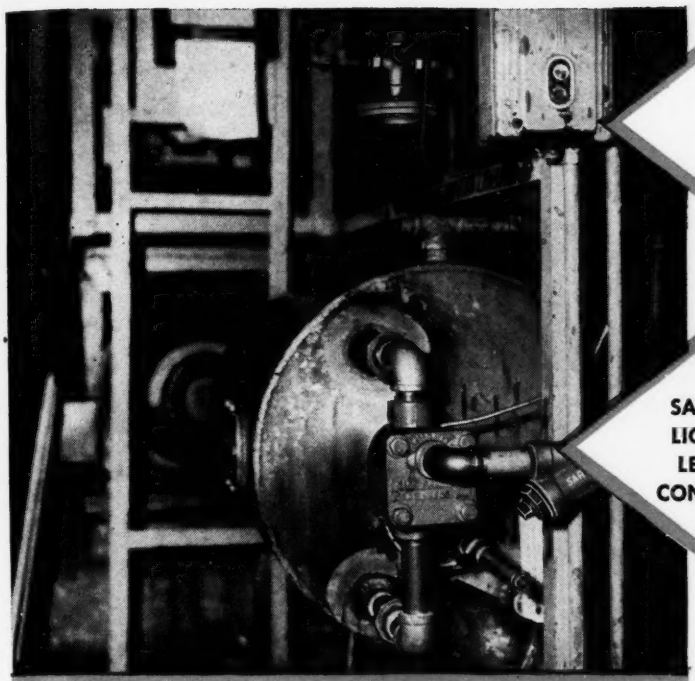


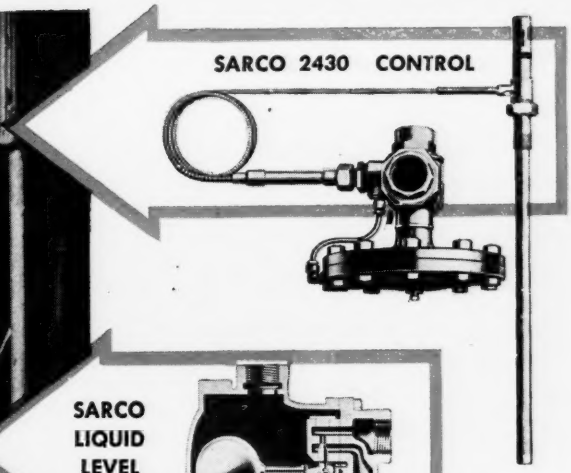
Compounding Laboratory

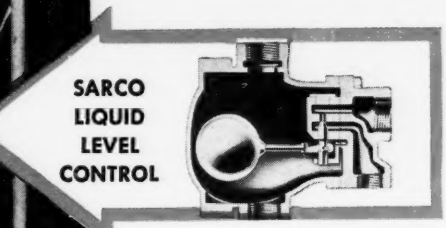


Chemical Laboratory

GARLOCK







KEEPING TEMPERATURES *Right* IN A PAPER MILL

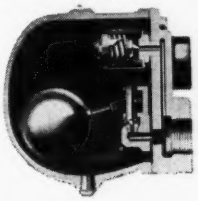
When you add special coatings to paper you have a temperature problem whether you want it or not.

Here is a plant that keeps temperatures right from the raw storage tanks to the final penetration rolls, with Sarco Steam Traps and Temperature Controls.

The illustration above shows how a complicated problem can be simplified with Sarco. The hot water heater for the rubber rolls on a waxing cylinder is kept at exact temperature by the Sarco 2430 Temperature Control. Water is added to the tank as needed by the Sarco Liquid Level Control.

On each paper machine all over the plant you will find batteries of Sarco Float-Thermostatic Steam Traps, one on each roll, and unit heaters are kept up to capacity by Sarco Bucket Steam Traps.

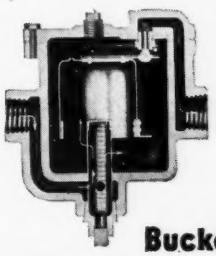
Thus four Sarco products have kept production up, rejects and fuel costs down for years in this plant. One kind of steam trap or temperature control is not enough for the average plant. The Sarco Representative has a complete line of both to select from and can give you the benefit of a quarter century experience in your special processes no matter what they may be. Ask for the Sarco Catalog.



Float

Sarco Float-Thermostatic Steam Traps are standard for waxers, storage tanks, mixers, penetration rolls in this plant.

-and the entire plant



Bucket

Sarco Bucket Steam Traps are standard for unit heaters in this plant.

190

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Yes, GÝROL FLUID DRIVE for adjustable speed control of mechanical draft fans and boiler feed pumps is getting more and more popular!

Why? Because Gýrol Fluid Drive saves power and increases over-all plant efficiency.

AMERICAN BLOWER CORP., DETROIT 32, MICH.
CANADIAN SIROCCO CO., LTD., WINDSOR, ONT.
Division of American Radiator & Standard Sanitary corporation

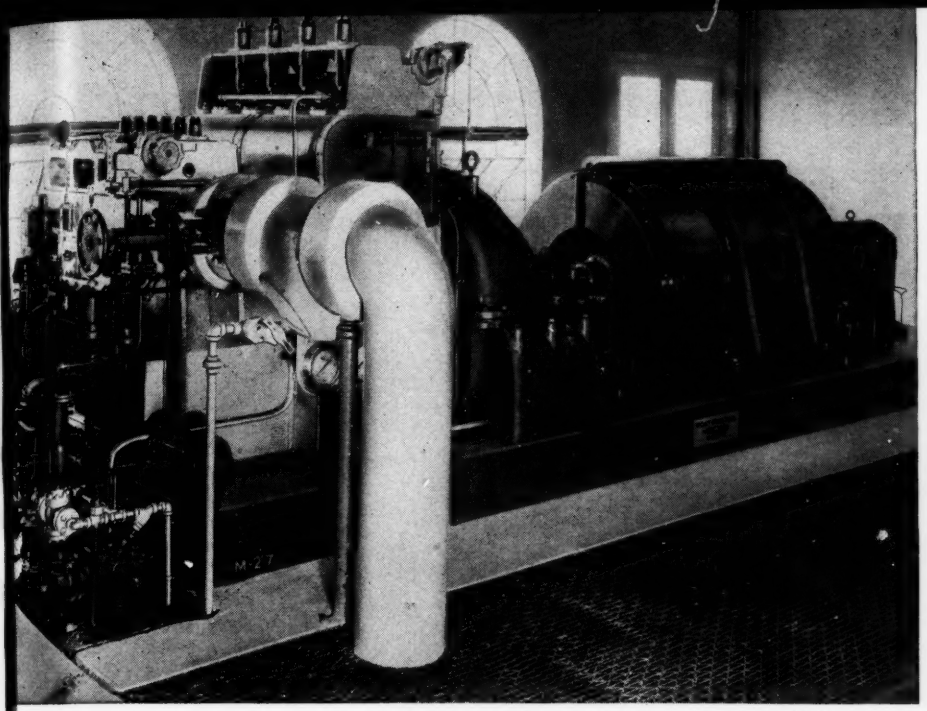
AMERICAN BLOWER

GÝROL *Fluid Drive*

NEWS

FROM THE POWER FRONT

AS REPORTED BY THE DEVELOPMENT ENGINEERS FIELD SERVICE REPRESENTATIVES AND CUSTOMERS OF WORTHINGTON



2000 kw Worthington Turbo-Generator—installed in 1937 at Detroit Lakes, Minnesota, power station.

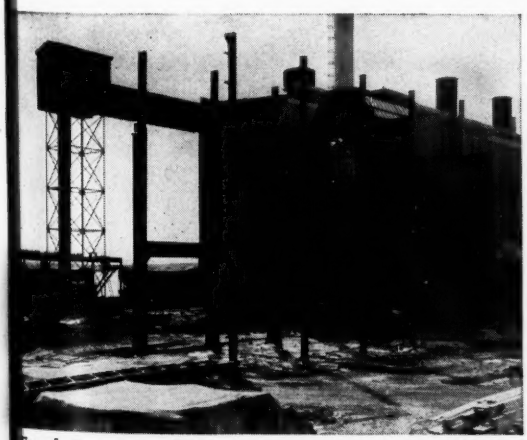
4000 kw More For Detroit Lakes

The City of Detroit Lakes, a bustling Minnesota resort center, has long taken pride in its municipally owned power plant. Through careful planning and good management, the plant has prospered . . . and the utilization of extracted steam from the generator units for heating the business district and public buildings is an advantage in Northern Minnesota measured beyond dollars and cents!

Detroit Lakes' order for a Worthington 4000 kw automatic bleeder turbine will bring to 7000 kw its total of Worthington installed turbine power. The first Worthington turbine, a 1000 kw unit, was installed in 1933; the second, a 2000 kw unit, in 1937.

The units have been inspected every two years and have been reliable and economical in operation.

Del-Mar-Va's Vienna Station Expands by Six Million



Foundations and turbine room, Vienna Generating Station of Eastern Shore Public Service Company of Maryland (United Engineers & Constructors, Inc., Philadelphia).

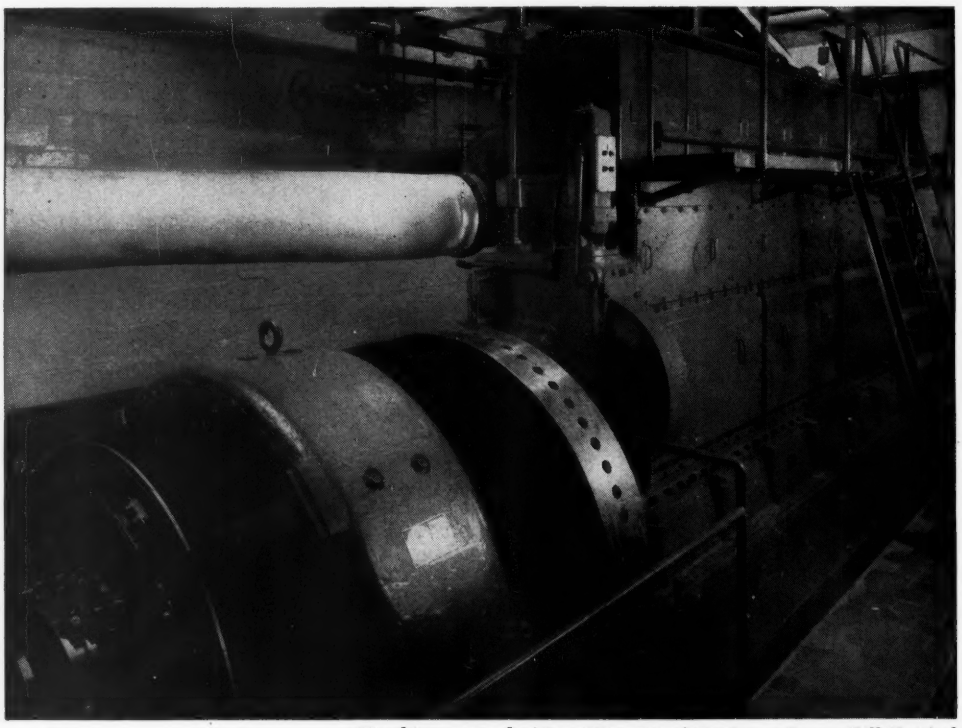
To provide more electrical energy to the Del-Mar-Va Peninsula, the Eastern Shore Public Service Company, a subsidiary of the Delaware Power and Light Company, is now undertaking a $6,000,000 expansion of its station in Vienna, Maryland.

Worthington was recently awarded the contract for the condensing unit to serve the latest 15,000 kw Turbo-Generator: a 14,000 sq-ft two-pass condenser with auxiliary equipment.

Four units are now in operation in this station—two 6,000 kw and two 7,500 kw. One 15,000 kw unit is being installed by the United Engineers and Constructors and a similar unit is on order. The two 6,000 kw generators operate at 300 psi, 675F, TT; the 7,500 kw and 15,000 kw units operate at 650 psi, 825F, TT.

IRTHINGTON PUMP AND MACHINERY CORPORATION, HARRISON, N. J.

NEWS from the power front



Worthington 750 hp Type EE-6 Diesel Engine at Lenox Hill Hospital.

Worthington Diesel at Lenox Hill Hospital

A 750 hp Type EE-6 Worthington Diesel engine installed in the power plant of Lenox Hill Hospital in New York City has helped to produce substantial savings in the cost of producing power during each operating month as compared with the previous steam engine installation.

Prior to the installation of the Diesel generating unit, power was furnished for 20 hours per day by a 400 kw steam engine generator unit, and during the balance of the day small steam engine generating units of 75 and 125 kw carried the load. With this arrangement, opportunity for adequate maintenance of the large engine unit was extremely limited. Then, too, during the warm weather months when demand for exhaust steam was at a minimum, a large amount of steam was wasted.

The new Diesel unit is the perfect answer to both these problems, being available at any time as standby for the large steam unit and eliminating the waste of exhaust steam during the warm months when it runs continuously.

The Diesel is a 6 cylinder, four cycle engine having 16 in. bore and 20 in. stroke. The starting air is supplied at 250 psi by a Worthington two-stage compressor. Jacket water, raw water and waste heat boiler feed pumps were all supplied by Worthington.

Million Dollar Baby

Installation of Model C Worthington Allspeed Selectors, at The Floyd A. Holes Co. plant in Bedford, Ohio, finally brought a well-deserved lay-off to a Model A Allspeed Selector purchased during the early part of the war.

It was originally put to work on a laminating machine making Grade C Type I ordnance wrap. The machine was then equipped with a ¾ hp motor. For a long time, the equipment was operated as hard as possible—from high speed to low speed about every 1½ minutes for 24 hours a day, seven days a week.

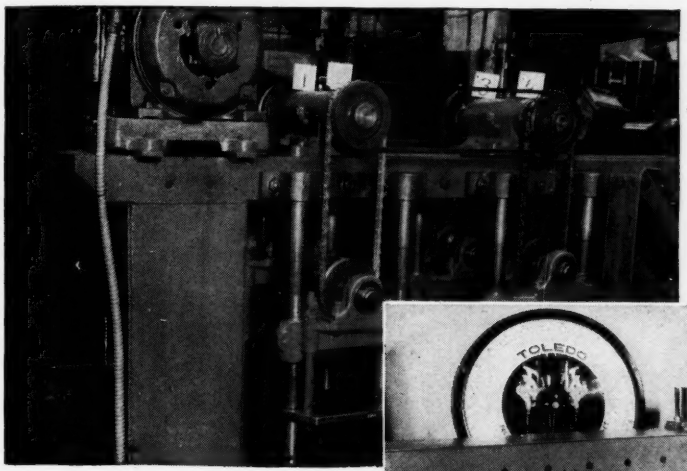
Then a 1 hp motor was installed—and later, a 2 hp motor. Finally, the drive—not intended for such heavy service—began to falter and was replaced with the larger Selector.

Mr. F. A. Holes reports:
"That little drive produced over a million dollars worth of Grade C Type I before we finally removed it from that operation. Since that time, we have placed it on several smaller operations, and we want you to know that it is still working perfectly today whenever we have occasion to use it. We believe that this is indeed a complimentary record for this piece of equipment and felt that you would like to know about it."

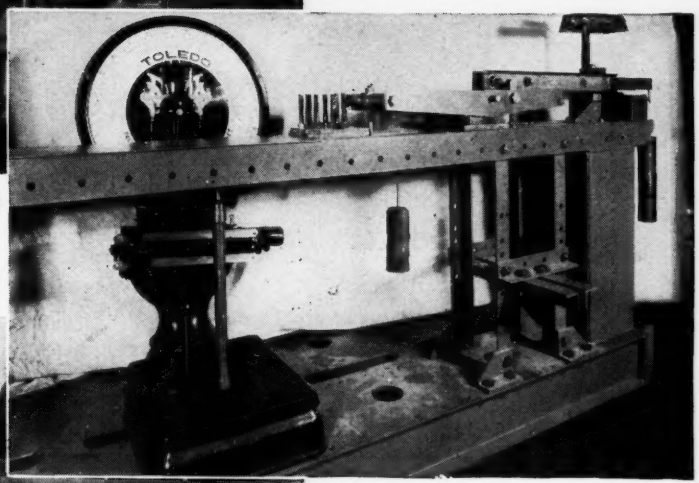
Worthington Pump and Machinery Corporation
Harrison, N. J.

NEWS

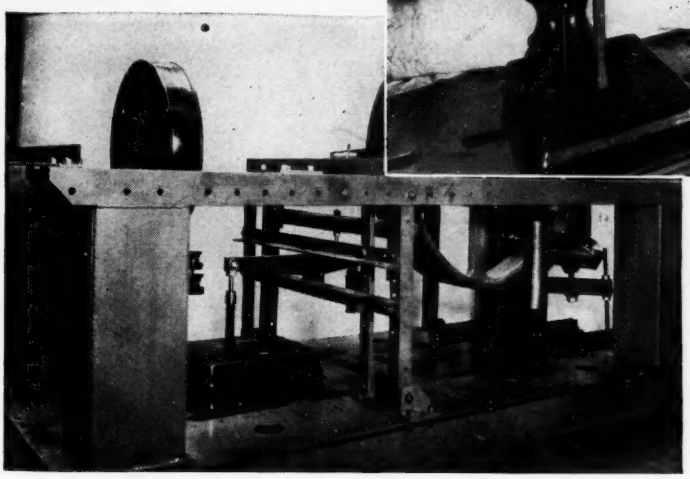
Universal Test Stand for Worthington Multi-V-Drives



Typical set-up of fixtures for comparative testing of Vee Belts to determine flex life and endurance under various speeds and loads. Photos taken in Worthington's Multi-V-Drive Research and Development Engineering Dept.



This fixture tests various kinds of steel and heat treatment on QD sheave hub pull-up bolts for wrench torque, elongation, elastic limit, ultimate strength and distortion in the thread lead relative to pulling power of bolt.



Static torque testing apparatus with rating up to 200,000 inch pounds torque determines cone grip capacity of QD sheaves and hubs. It permits mechanical or electric detection of cone slip in minute proportions.

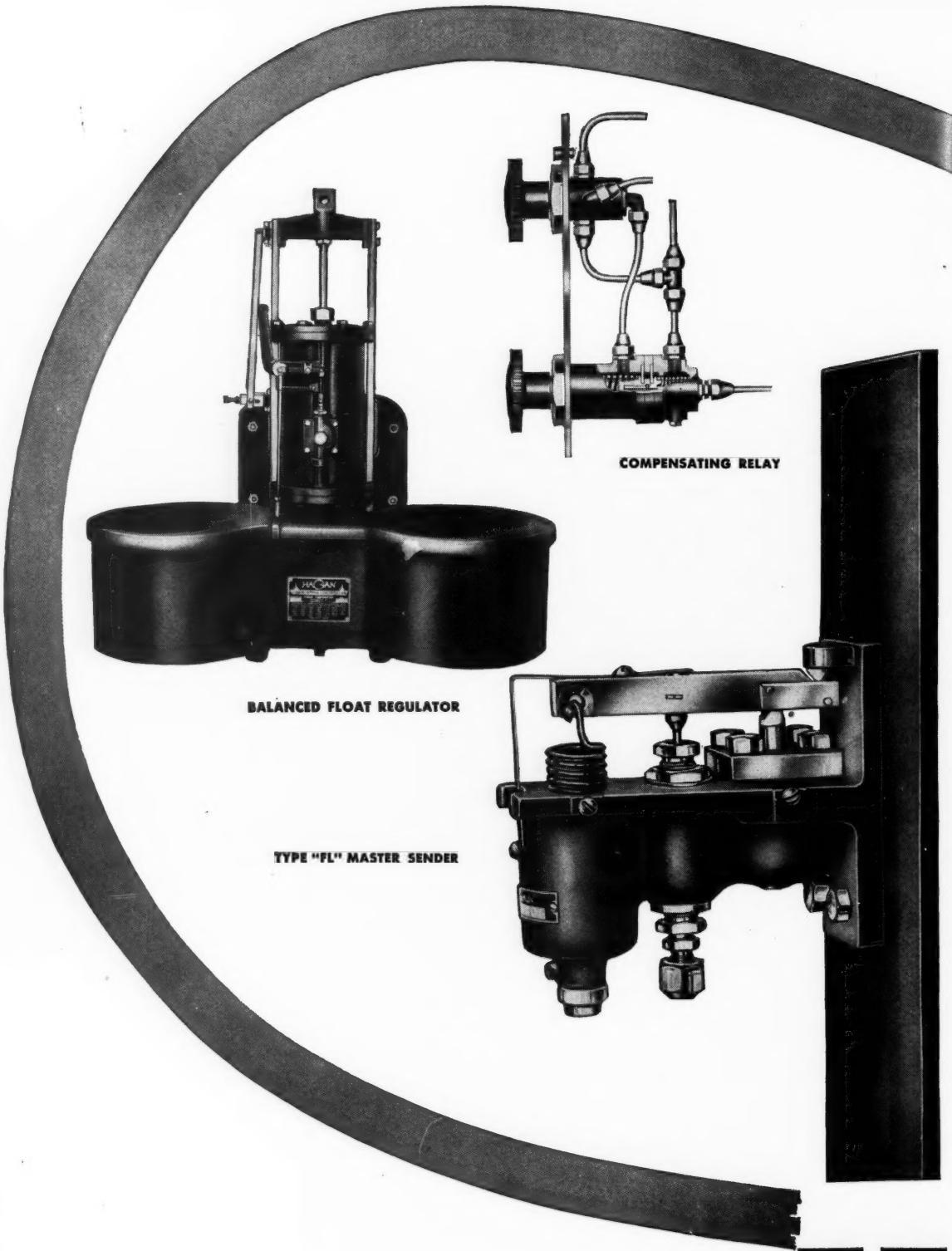
It's a Long Drink from Arkansas to Chicago

Mountain Valley Water Company supplies bottled water to thirsty Chicagoans, all the way from Hot Springs, Arkansas. Until this past summer, the water had been shipped in 30-gallon drums. Unloading these drums from freight cars at the Chicago end took four men about five hours per freight car load of 5500 gallons.

Last May two 8000-gallon tank cars were leased. When the water arrives in Chicago, the tank is hooked up with a Worthington Monobloc Centrifugal pump in the basement of the bottling plant, and within two hours, the water has all been transferred to stainless steel storage tanks on the fourth floor of the building. Labor cost involved is just for starting and stopping the pump motor.

The pump is 3 hp, 3600 rpm, with a 3-phase, 220/440 volt drip-proof motor.

COMPENSATING RELAY



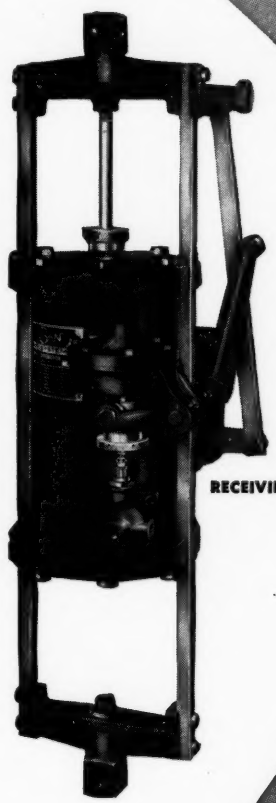
BALANCED FLOAT REGULATOR

TYPE "FL" MASTER SENDER

HAGAN
HALL
BUROMIN
CALGON

Fuel Economy

FOR SMALLER PLANTS



RECEIVING REGULATOR

Fuel economy has made automatic combustion control standard equipment in virtually every large power plant.

Fuel economy through automatic combustion control is just as important in small plants. Control systems in these plants need not be as elaborate as in larger plants, but they must meet large-plant standards of quality and performance, and their cost must not be out of proportion to the savings they produce.

The Hagan simplified automatic control system meets the needs of these plants. For some plants this may consist essentially of only the Hagan Master Regulator and one or more Hagan Balanced Float Regulators. Others may require the Hagan Unit Control System, with the Hagan Master Sender supplying a loading for relays and power units regulating air and fuel input, and with the Hagan Type D Regulator and Receiving Regulator maintaining constant furnace draft.

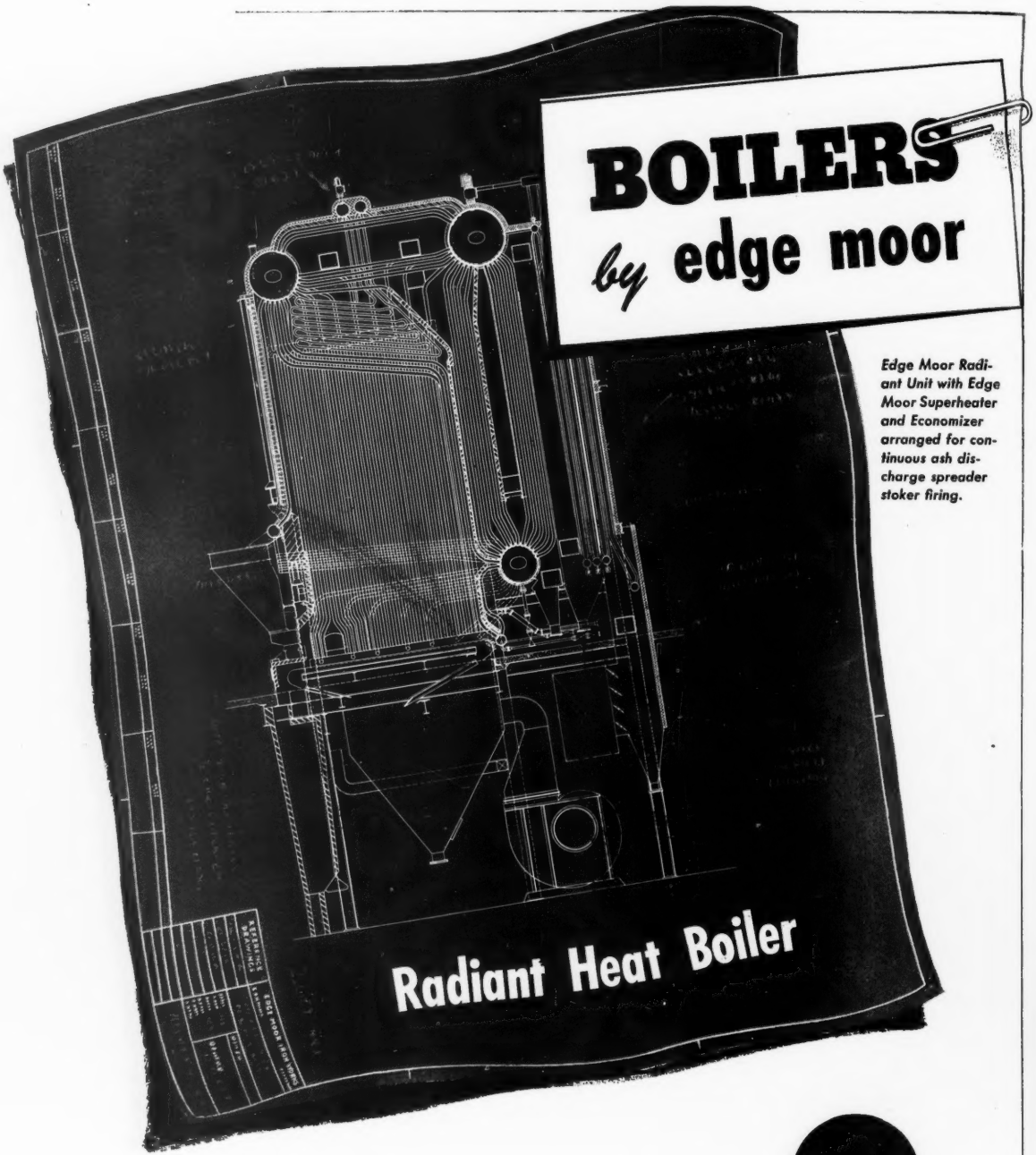
In either case, the result is a rugged, efficient system that *pays for itself* in lower fuel costs.

Our engineers will be glad to show you how a *simplified* Hagan system will meet the needs of your plant. Write for full information.

Hagan Corporation, Hagan Bldg., Pittsburgh 30, Pa.

HAGAN CORPORATION

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES



Edge Moor Radiant Unit with Edge Moor Superheater and Economizer arranged for continuous ash discharge spreader stoker firing.

Here is a unit designed to give the advantages of a 3-drum boiler, maximum boiler tube surface exposed to radiant heat and a water-cooled furnace—all in a minimum of space. Advantages include large water storage, generous steam liberation surface and quiet offtake drum. This quick-steaming unit delivers continuous high ratings over many years and is adaptable to all fuels.

This and other types of Edge Moor boilers are available in a wide range of capacities, pressures and accessory equipment. Write for literature today. EDGE MOOR IRON WORKS, INC. Main Office and Works: Edge Moor, Delaware. Branch Offices and Agents: Atlanta, Boston, Chicago, Detroit, Hoboken, St. Paul, San Antonio and San Francisco.

EM

edge moor

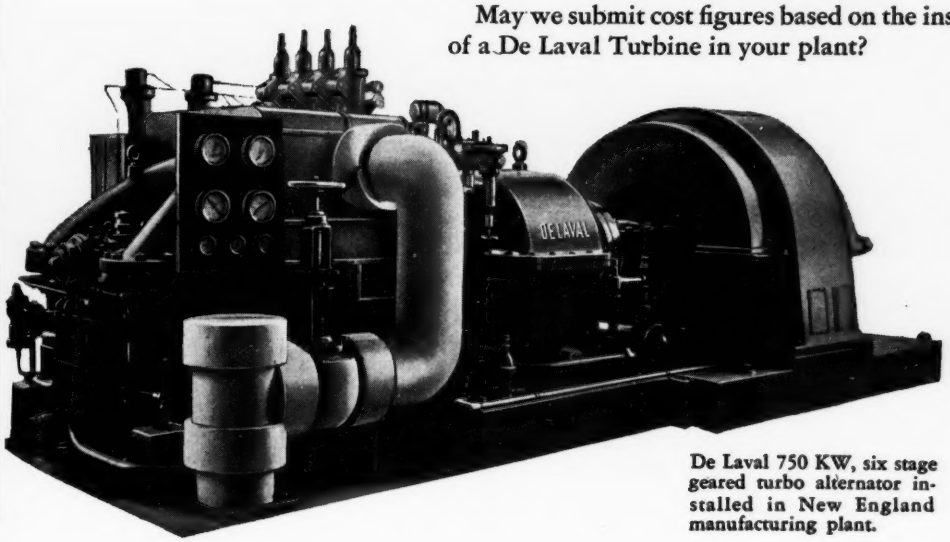
steam generating equipment

where there is HEAT there is POWER

Don't overlook the economy of generating your own power with a De Laval turbine wherever appreciable quantities of steam are required for heating buildings, dryers or processes.

In many installations the entire cost of the turbo-generators and auxiliary equipment has been repaid in two or three years. In fact, the installation of a modern high pressure steam plant often results in the production of both power and process steam at a fuel cost no greater than that entailed for the production of process steam alone, with older equipment.

May we submit cost figures based on the installation of a De Laval Turbine in your plant? T-6



De Laval 750 KW, six stage geared turbo alternator installed in New England manufacturing plant.

DE LAVAL
STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

Atlanta • Boston • Charlotte • Chicago • Cleveland • Denver • Detroit • Helena • Houston • Kansas City
Los Angeles • New Orleans • New York • Philadelphia • Pittsburgh • Rochester • Salt Lake City
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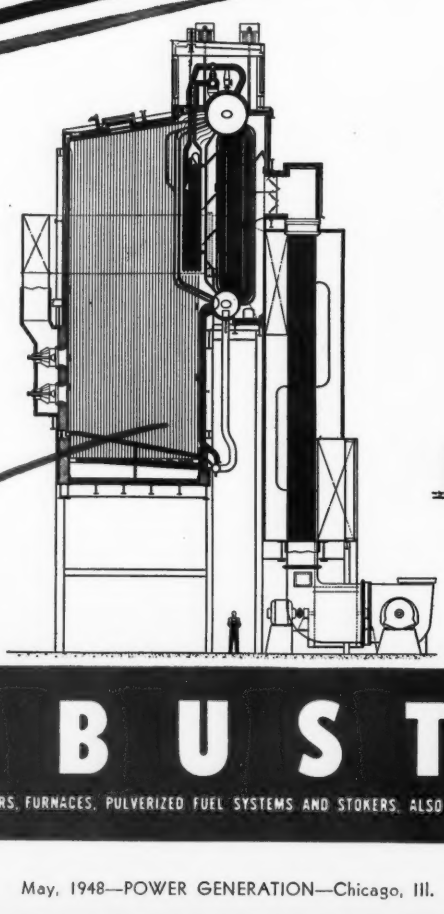
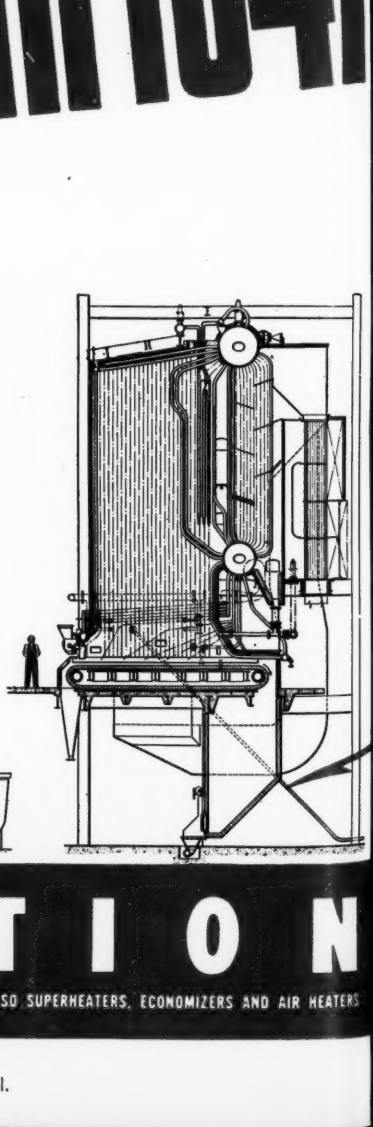
utilities set new VU record in 194





350,000 LB OF STEAM PER HR
Design pressure 1000 psi
Total steam temp. 905 F
NATURAL GAS AND OIL

COMBUSTION E

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS. ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

Public u
preferen
ordering
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Indivi
lb per hr
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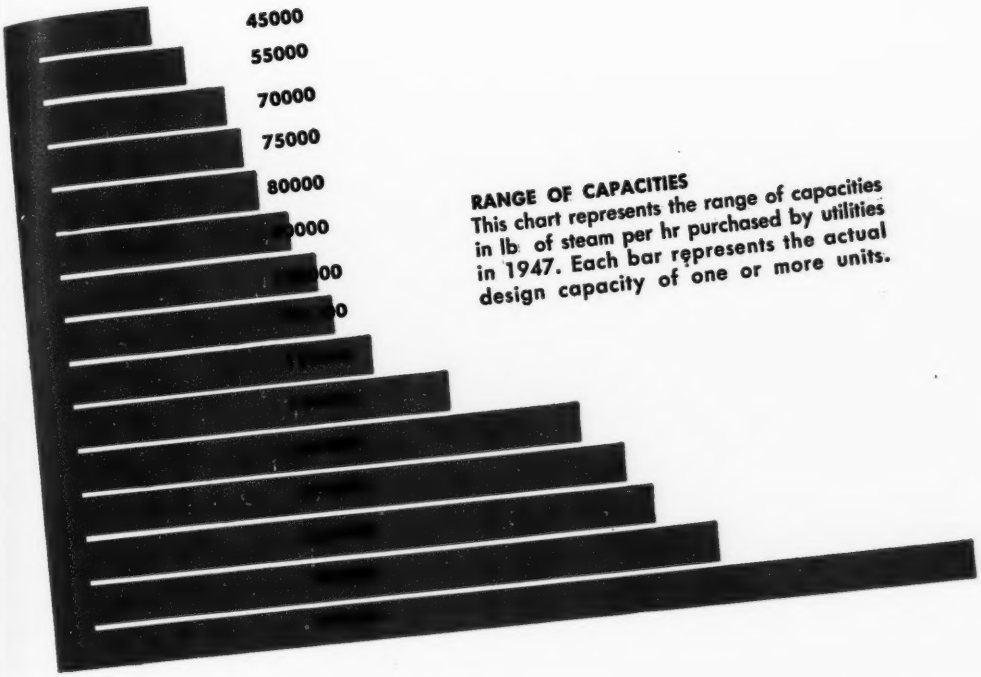


RANGE OF CAPACITIES
This chart represents the range of capacities in lb of steam per hr purchased by utilities in 1947. Each bar represents the actual design capacity of one or more units.

Public utilities in 1947 again registered an increasing preference for the versatile VU steam generator by ordering and installing units with an aggregate capacity of well over 6,500,000 lb of steam per hr.

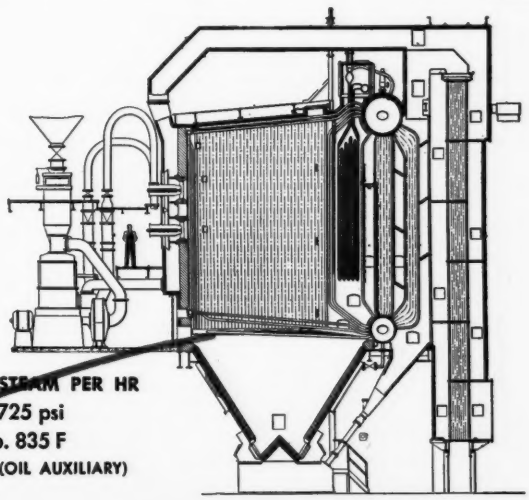
Individual capacities ranged from as low as 45,000 lb per hr up to 350,000 lb per hr; pressures varied from 150 psi to 1000 psi; temperatures climbed to 910 F. More important, perhaps, to hard-pressed small and medium-sized utilities was the flexibility afforded in the use of available fuels and the freedom of choice in firing methods – at efficiencies as high as 88 per cent.

With the VU virtually all fuels and methods of firing have been applied – oil, coal and gas (separately and in various combinations), with coal fired by spreader, underfeed and traveling grate stokers, as well as in pulverized form.

Such versatility eliminates geographical limitations and – as would be expected – VU Units are now in service throughout the United States, in Canada, Latin America, and the more remote parts of the world.

Note the variable design characteristics of the three 1947 utility units illustrated. These indicate the exceptional adaptability of the VU to widely differing conditions. Small wonder that more and more utilities are turning to the versatile VU Unit. If your requirements fall within its capacity range, let C-E engineers check your needs against VU versatility and performance.

B-210

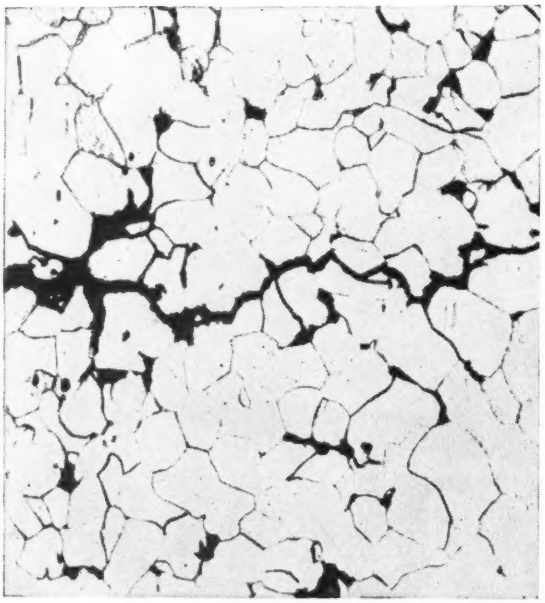


100,000 LB OF STEAM PER HR
Design pressure 450 psi
Total steam temp. 750 F
CONTINUOUS DISCHARGE SPREADER STOKER

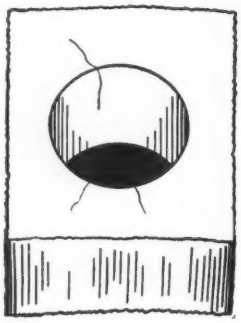
150,000 LB OF STEAM PER HR
Design pressure 725 psi
Total steam temp. 835 F
PULVERIZED COAL (OIL AUXILIARY)

C-E ENGINEERING
200 MADISON AVENUE, NEW YORK 16, N. Y.

What a



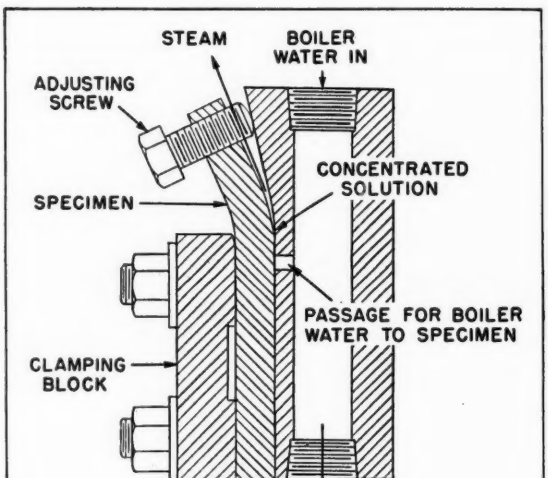
THIS photomicrograph shows the typical intercrystalline cracking which may occur along riveted seams and rolled-in tube ends. Physical conditions which favored its development were stress in the metal and the presence of tiny crevices which permitted the boiler water to concentrate by evaporating to a region of lesser pressure. Overheating was not a factor.



Left: Early stage of cracking at edge of rivet hole.

It is generally agreed that the chief chemical factor in cracking of this type is high alkalinity, hence the name "caustic embrittlement." Maintenance in the boiler water of certain optimum sulfate-alkalinity ratios has been quite widely relied on to combat it.

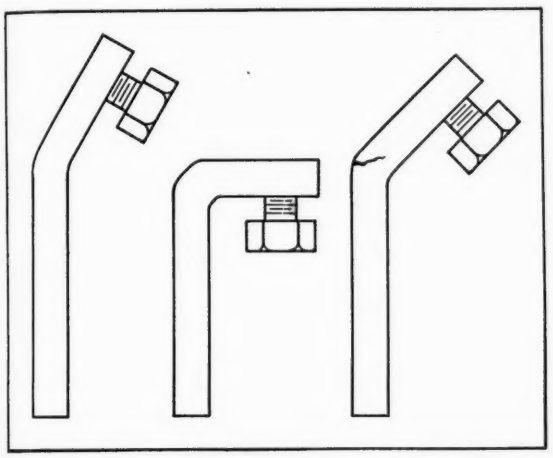
Hall Laboratories undertook an experimental study of the problem, using embrittlement detectors which were installed on dozens of operating boilers. These detectors simulate the physical conditions under which caustic embrittlement may occur, leaving the boiler water itself as the



Embrittlement Detector

HAGAN
HALL
BUROMIN
CALGON

...at about embrittlement?

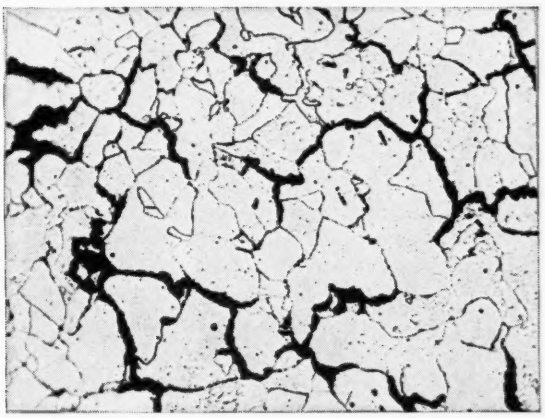


Contrast between effect of non-embrittling and embrittling boiler water on test specimen.

variable. The condition of the steel specimen after definite periods of exposure, is the measure of the embrittling tendency of the water.

This study made it clear that no sulfate-alkalinity ratio is an adequate preventive. It showed, however, that other available procedures can be effectively applied to inhibit this type of embrittlement.

Because it was assumed that concentration of caustic could not occur in the absence of capillary openings such as those in riveted seams, embrittlement was not expected in the modern boiler with forged or welded drums. Actually, however, a distinctive type of embrittlement does occur in the tubes of such boilers, where it is characterized by breakdown of grain boundaries and consequent weakening of the metal over a wide area.



Effective prevention of either type of embrittlement requires that every boiler be considered as a separate problem. In this, as in all other matters related to the industrial uses of water, Hall Laboratories takes all factors into account and recommends procedures which are best fitted to *your specific situation.*

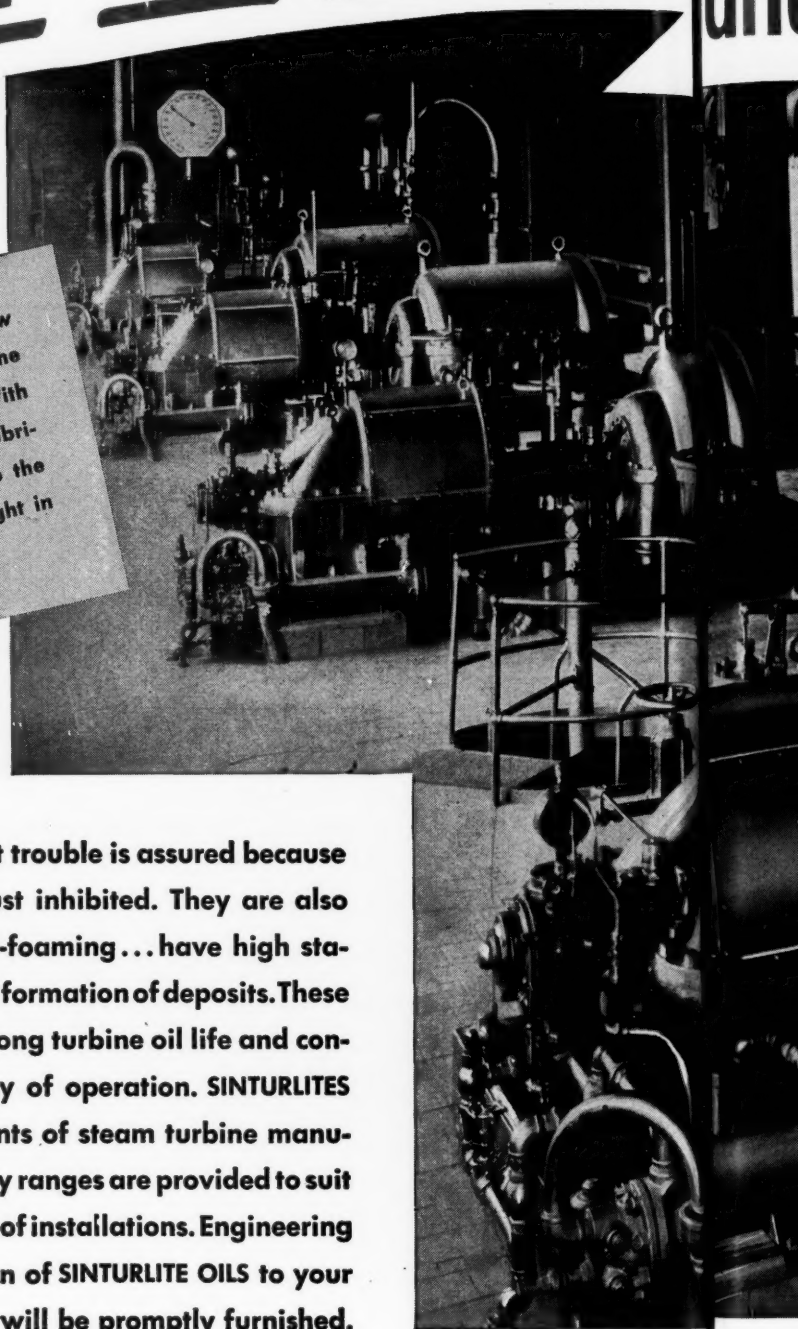
Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

HALL LABORATORIES, INC.

(A Subsidiary of Hagan Corporation)

CONSULTANTS ON
INDUSTRIAL WATER TREATMENT
HALL SYSTEM OF BOILER WATER CONDITIONING
INDUSTRIAL WASTE RECOVERY AND DISPOSAL

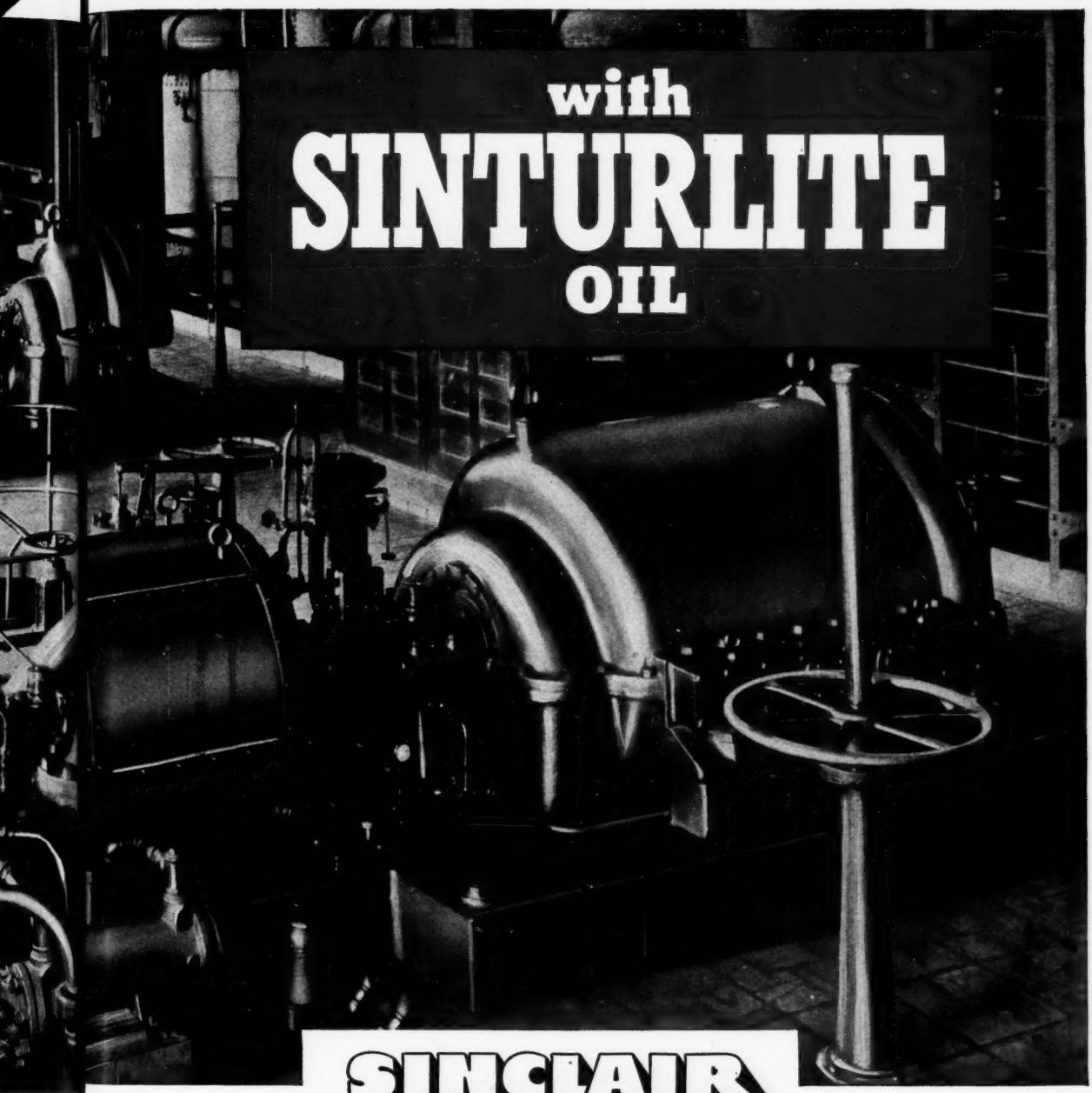
START-UP RIGHT



Rusting is a trouble common to new steam turbine systems unless the right oil is used at start-up. With Sinclair SINTURLITE Oil as the lubricant, the installation is off to the right start-up and it stays right in service operation.

Protection against rust trouble is assured because SINTURLITE OILS are rust inhibited. They are also anti-oxidant and non-foaming... have high stability and resistance to formation of deposits. These characteristics mean long turbine oil life and continuous high efficiency of operation. SINTURLITES fully meet requirements of steam turbine manufacturers. Five viscosity ranges are provided to suit varying requirements of installations. Engineering counsel on application of SINTURLITE OILS to your lubrication problems will be promptly furnished.

and STAY RIGHT

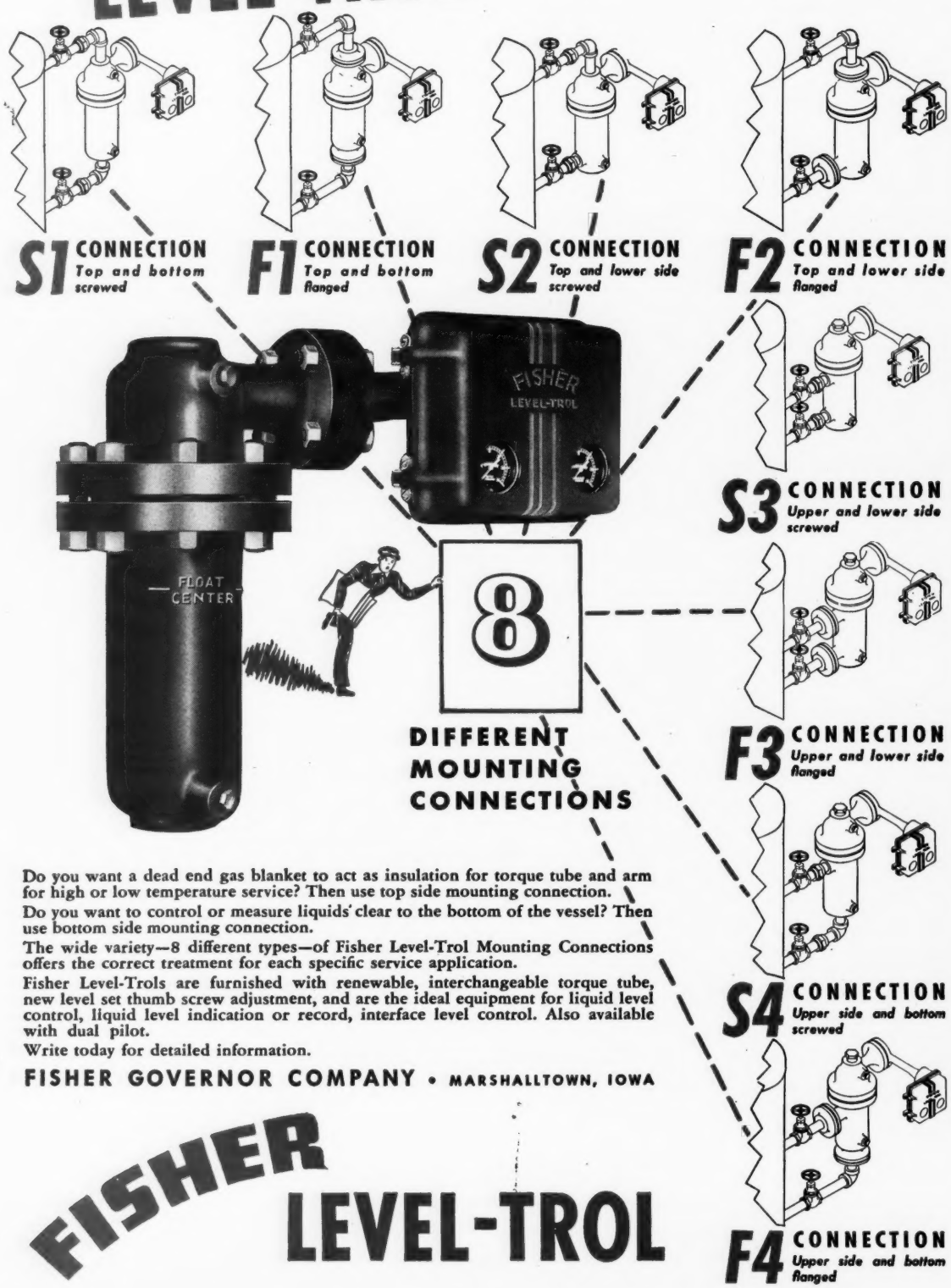


SINCLAIR

INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL
WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVE., NEW YORK 20, N. Y.

THE RIGHT CONNECTION FOR YOUR LEVEL-TROL INSTALLATIONS



Do you want a dead end gas blanket to act as insulation for torque tube and arm for high or low temperature service? Then use top side mounting connection.

Do you want to control or measure liquids clear to the bottom of the vessel? Then use bottom side mounting connection.

The wide variety—8 different types—of Fisher Level-Trol Mounting Connections offers the correct treatment for each specific service application.

Fisher Level-Trols are furnished with renewable, interchangeable torque tube, new level set thumb screw adjustment, and are the ideal equipment for liquid level control, liquid level indication or record, interface level control. Also available with dual pilot.

Write today for detailed information.

FISHER GOVERNOR COMPANY • MARSHALLTOWN, IOWA

FISHER LEVEL-TROL

DESIGN
MANUFACTURE
ERECTION

"packaged"
coal-handling systems
by G-W. These three basic systems for handling coal (and/or ashes), designed by G-W, have been adapted to varying conditions in boiler plants.

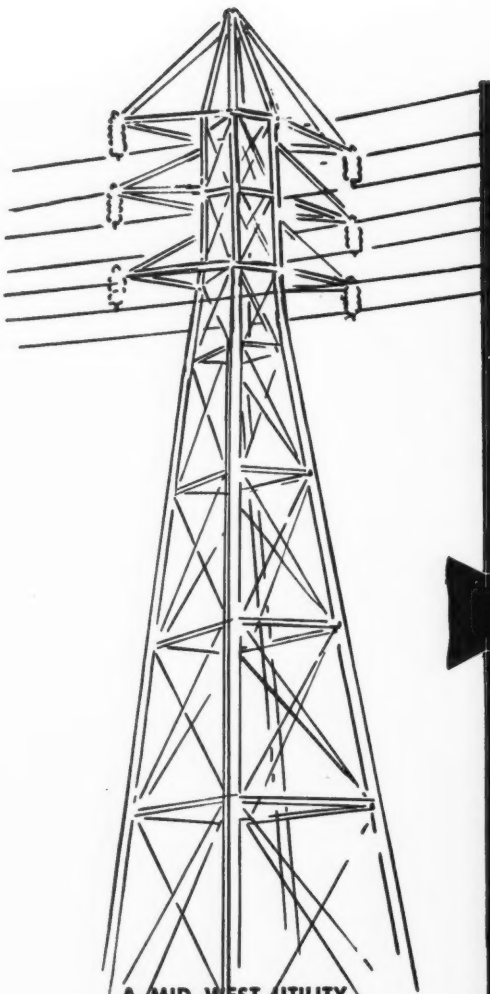
Let G-W do the entire job for you...design, manufacture, erection . . . shoulder all details . . . assume all responsibilities.

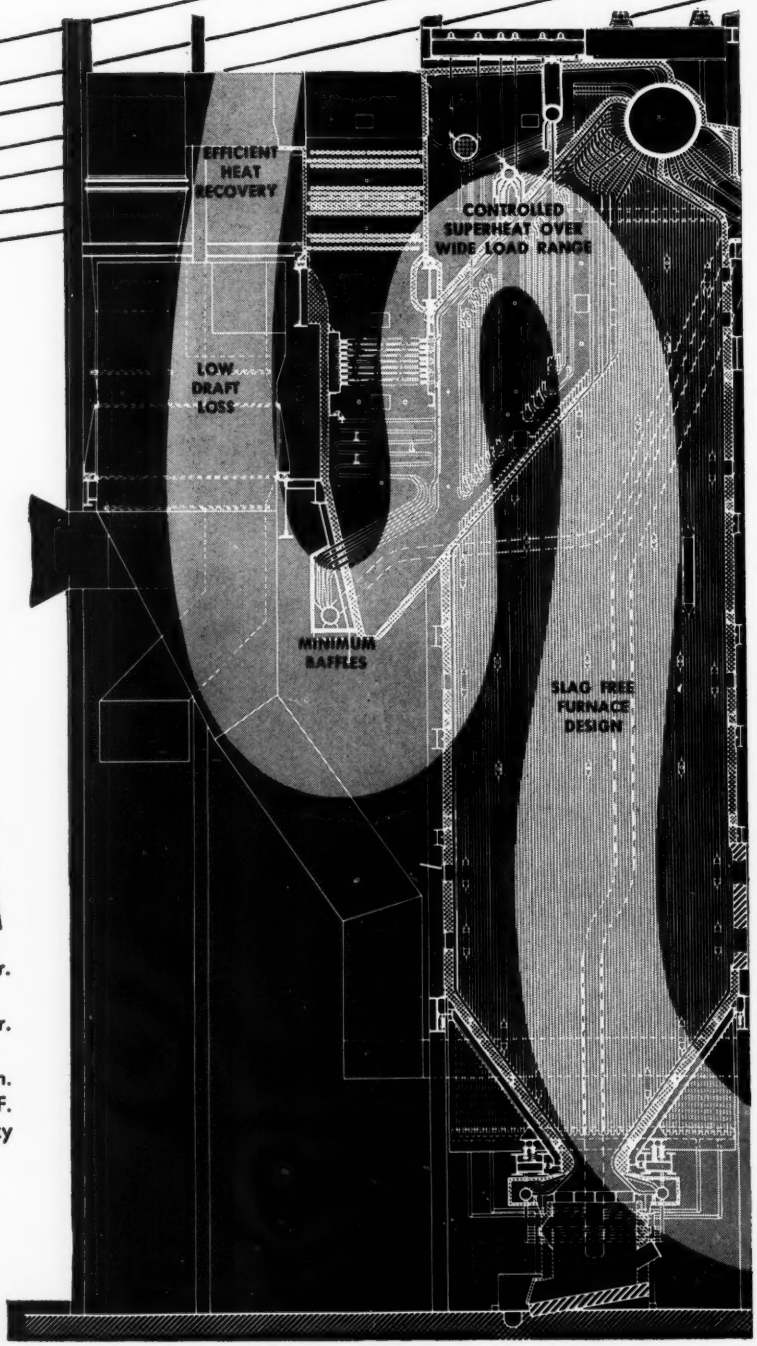
GIFFORD-WOOD CO.

Since 1814

420 LEXINGTON AVENUE • NEW YORK 17, N. Y.
565 W. WASHINGTON STREET • CHICAGO 6, ILL.
Factory — Hudson, N. Y.

YOUR DOLLARS





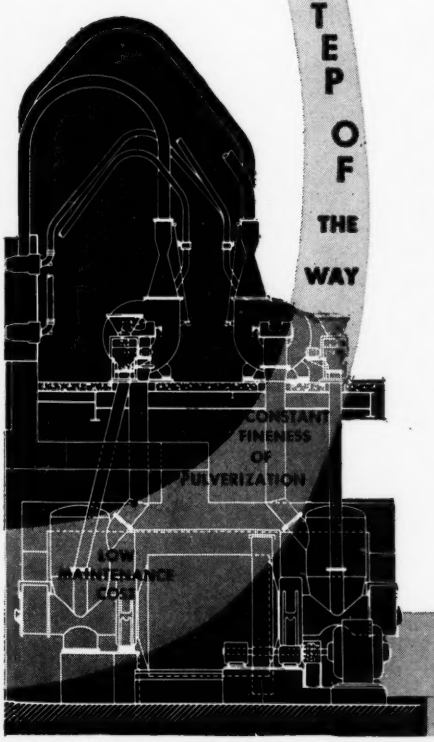
A MID-WEST UTILITY

Steam capacity.....640,000 lb. per hr.
Superheat control range
245,000 to 640,000 lb. per hr.
Pressure superheater outlet
950 lb. per sq. in.
Final steam temperature.....900 deg. F.
Pulverized coal.....West Kentucky

FW

MORE POWER AT LOWER COST

PROTECTED EVERY STEP OF THE WAY



The steam generator shown here incorporates an exclusive Foster Wheeler design feature which tends to eliminate baffles. This means—

- *extremely low draft loss;*
- *negligible baffle maintenance.*

Also because of careful design and proportioning of a completely water-cooled furnace—

- *the problem of slagging is eliminated.*

The convection heating surface of the boiler proper consists of waste heat type elements made up of bare and extended surface tubes in series with each element having separate risers to the steam drum.

Foster Wheeler maintains a top place in the field of steam generation by designing and constructing equipment which meets the ever-existing demand for improved efficiency of power generation.

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NALCO DELIVERS

Continuous Benefits

TO REFRIGERATION USERS

Here's Proof: Of the many plants using Nalco service and chemicals for efficient performance of refrigerating systems:

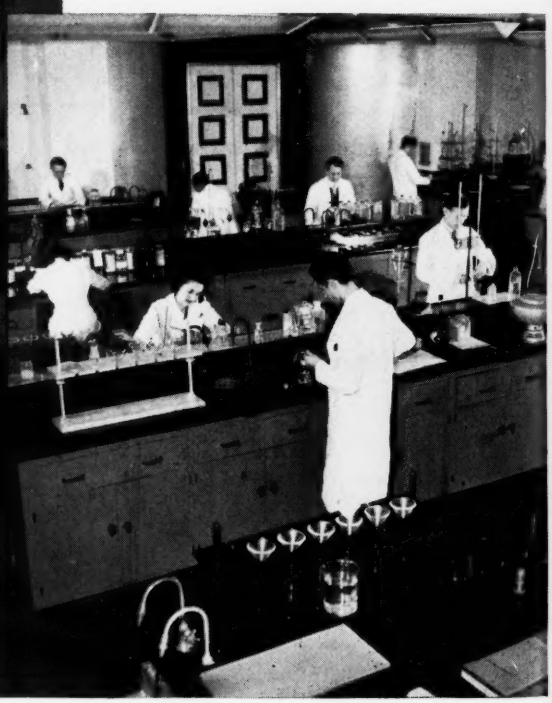
68% have been using the Nalco System for over 5 years;

54% have employed Nalco for more than 10 years, and

69% of this over-10-year group have enjoyed freedom from water treatment failures for more than 15 years.

You do not buy a product or a service year after year unless it is continuously successful. For a permanent answer to your water treatment problems, consult Nalco.

Laboratory samples of living algae used for experimentation work in the constant battle against the green marauders.



The facilities of the world's finest water treatment laboratories are at the service of Nalco users.

Prevent scale, corrosion, algae in cooling towers, diesel cooling systems, condensers, boilers, recirculating water systems with Nalco Treatment.

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HELPFUL BULLETINS

BOILERS, ACCESSORIES

1 Boiler Furnace Refractory Brick—How refractory brick is made, how it should be used and the results to be expected are described and explained in this 16 page bulletin which utilizes application photos and sketches to show where and how these special high heat resistant brick should be laid. Norton Co.

2 Steam Generators—These steam generators, specially designed and engineered for general heating and steam processing, are described in 4-page bulletin. A cut-away view shows whirling hot gases passing full length of boiler three times to extract more heat from less fuel. Other photographs show the instrument and control panel and the induced draft fan of the steam generator. A series of illustrations indicate stoker, hand, oil and gas fired methods that can be used in the self-contained portable horizontal return tubular type generator. Other vertical boilers and boiler feed pump and condensate return system are illustrated and described. C. H. Dutton Co.

3 Boilers—A line of "hot steam" boilers is described in this 4-page Circular 127. The illustrations show the fully automatic boiler as it is completely assembled at the factory. The boilers are indicated to run from sizes 3 to 50 hp, gas or oil fired. Also described are a standard and an insulated boiler. Alert Engineering Products Co.

4 Water Tube Boiler—A horizontal water tube boiler is described in this 8-page bulletin. The general characteristics of this type boiler are listed. The various sections of the unit are explained and illustrated. It is indicated that the boiler has many users because of its large water and steam capacity and because it is a steady steamer. Three views show removable sediment collecting pan arranged over rear water leg and fastened to rear course of boiler drum. Erie City Iron Works.

5 Automatic Combustion Control—This 4-page bulletin explains how and why use of the device described can save money on fuel oil burning instalations. Line drawings and installation photos give method of application. Reasons are presented why device saves oil. General Power Plant Corp.

6 Soot Remover—This is a catalog sheet that describes how the soot remover that this firm makes removes soot. It explains what the product is and what advantages it has. Instructions are given for use with various methods of firing. RX Chemical Co.

7 Saving Money on Fuel—This is a 20-page book which explains how to save money on coal as a fuel not only from the proper operation standpoint but also from the buying standpoint. The location of suitable fuels and the transportation methods and charges as well as reserves of various sections are given. The technical factors of coal are discussed and their effect upon design of furnaces shown. The effect of burning equipment and auxiliaries such as jets and collectors on efficiency are discussed. Ohio Coal Association.

ELECTRICAL

8 Small Distribution Transformers—Bulletin 61B6159A describes and illustrates 100 kva and less transformers made by this firm for pole mounting, substation, or interior plant location. Mechanical data on the various volt classes is listed with dimensions for space and mounting allotments. Connections for low voltage side are given. Prices are listed for various sizes. Allis Chalmers.

9 Industrial Batteries—An 8 page fold out sheet that presents the line of industrial batteries made by this firm suitable for many different purposes. Types, ranges of plates, range of capacity, size, are all given with each specific type of battery. Gould Storage Battery Corp.

10 Selenium Rectifiers—This is a catalog sheet presenting basic rectifiers of 250 to 2000 amp, self contained rectifiers of 250 to 1500 amp, Stepless variable controls of 250 to 4000 amp, and combination rectifiers of 250 to 2000 amp. Richardson-Allen Corp.

11 Dry Type Load Center Transformers—A 20 page bulletin describing the dry type Class B insulated load center transformers for plant power distribution. Available in 3 phase, 60 cycle, 100 to 2000 kva with high voltages from 2400 to 14,400 and low voltages from 600 to 240 or 208Y/120. Wagner Electric Corp.

12 Fuse Booklet—An excellently done 16-page pocket-sized booklet on the outstanding features of construction of this fuse (such as the renewable link and spring tension locking of links in circuit) was issued recently. Easily-understandable full-page wash drawings are used to emphasize every feature discussed. Two pages of prices and specifications on the fuses are given in the back of the book. Ware Brothers.

13 Complete Building Wire Manual—A new 48-page booklet, H-408, on building wire, "Hazard Building Wires", has been issued. Fully illustrated, this manual contains complete engineering information on the many types of wire and cable required by the building industry.

Full descriptions of and specifications for the various insulations used in building wires are given together with recommendations for their use. Tables showing dimensions and weights of all cable constructions are also included as well as a section devoted to valuable engineering data for added convenience in planning new wiring and rewiring of electrical installations. The Okonite Company.

14 Standby Electric Power—This interesting, 8 page, Form A-194, folder describes how standby electric power provides protection from electric powerline breakdowns. A table of capacities of emergency plants is included along with a description of the automatic a-c line transfer controls to switch over the electrical load to the standby unit. D. W. Onan & Sons, Inc.

15 Voltage Controllers—Bulletin 547, 12 pages, lists the products of this company. All the models available are described showing different mountings and dimensions necessary. Motor-driven, oil-cooled line correctors, regulated and unregulated models, and instantaneous electronic models. Specifications for different models. A full page of line drawings showing connection arrangements. Handy reference for use with voltage controllers. The Superior Electric Co.

16 Short Circuit Protection—Bulletin 3100-PRD-192, 8 page, 3 ring punched, describing this firm's high voltage protection units. These enclosed, high-voltage combination starters for motors from 2300 to 4600 v are preengineered. Prices of different units are listed depending upon capacity and whether with blade disconnects or circuit breakers. Illustrated to show how the control works. Facts on polarized field frequency synchronous motor control and two full pages explaining how high-interrupting capacity fuses provide short-circuit protection. Electric Machinery Mfg Company.

PIPING, VALVES, TRAPS

17 Industrial Steam Traps—Bulletin No. 1047 describes steam traps with bellows of bronze, Monel, or stainless steel. Sizes are ¼ to 2 in. and for all pressures from vacuum to 300 psi. Capacities and dimensions are given with piping diagrams, typical applications, table and data covering the selection of traps. W. H. Nicholson & Co.

18 Color Scheme for Piping Identification—This 4 page folder will be of value to the man who has to set up a color scheme for quick identification of piping. Presents possible color codes to be followed for piping in these services: fire protection, steam, water, compressed air, combustibles and lubricants, and miscellaneous. Sizes of lettering are recommended, and a typical application is shown for clarification. Rust-Oleum Corporation.

19 600 lb Forged Steel Valves—This 16 page catalog describes design and construction, materials, ratings and markings. Forged steel gate valves, union bonnet and bolted bonnet; globe and angle, O.S. and Y. union and bolted bonnet; check valves, horizontal, lift union and bolted cap are all described. Ohio Injector Co.

20 Precision Control Valves—Catalog No. 17, 48 pages, lists all the valves this firm makes for all pressure ranges up to and including 2500 lb. Illustrated with line drawings, pictures, tables, and curve charts that indicate characteristics, specifications, and applications, of the line of valves for both hand and power control. Controls may be had with hydraulic, pneumatic, or motor power. Featured is the automatic pressure differential control. R-S Products Corp.

21 Valve Catalog—This is the catalog of this maker of valves. Dimension drawings, flange tables, photos of valves, types of controls, cutaway drawings to show operation, make up the illustrations of this catalog. Listed are: slide valves, butterfly valves, threaded and flanged, and automatic and power operated control valves. All the different ways of controlling valves by hand are shown. Specifications given for each valve. W. S. Rockwell Company.

PUMPS

22 Practical Pumping Problems—This 18 page bulletin presents the possibilities for lengthening pump life with firm's product. Text and application photos show how the use of different metals suitable for handling various liquids help. Stories are presented for reciprocating, centrifugal, deepwell, and rotary pumps. Two pages tell how to select a metal for pumping a corrosive. International Nickel Co., Inc.

23 Speed Prime Pumps—In this 12-page Bulletin No. 47-12 the design advancements for these pumps are described in detail and pictured by cutaway and enlarged photos. Included are detailed specifications and helpful application information. This data shows how to figure the right pump for the job. A sample problem is presented and a mathematical solution is derived. Four tables show water friction in 100 ft of pipe, practical suction lifts for various altitudes, water friction in 90 deg elbows and pressure conversion. Chain Belt Co.

24 Portable Light Weight Pumps—Handiness is the feature of the equipment that this bulletin highlights. Centrifugal pumps driven by single cyl gasoline engines are described in 3 different sizes. Cutaway views show operation. Specifications are given. The Gorman-Rupp Company.

25 Controlled Volume Pumps—A 28 page Catalog No. 146 with supplemental order sheets. The construction and operation of these controlled volume chemical and high pressure pumps is shown with

May, 1948

GENERATION POWER

53 W. Jackson Blvd.
Chicago 4, Illinois

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cutaway drawings, application photos, and combinations to show the special features. Capacity-pressure selection tables are included to aid in selection of pumps as are tabulations of materials for use in handling different liquids. Milton Roy Co.

INSTRUMENTS AND CONTROLS

26 **Chemical Feeders**—A 12 page bulletin that tells why chemical feeders are necessary and the 2 systems to which they are applied; type S for constant rate intermittant, and type P for proportionating continuously. With line drawings the application of the feeder to the different systems is shown. Wet feeders and dry feeders are discussed with attention on equipment needed. Liquid Conditioning Corporation.

27 **Electric Contact Controller**—Bulletin No. 98098 graphically describes new Electric Contact Controller, indicating or recording, for on-off applications involving temperature, pressure, flow, liquid level or humidity such as ovens, driers, heaters, vats, cookers, tanks, etc. Photographs together with construction and application drawings. Taylor Instrument Companies.

28 **Fire Alarm Systems**—Reference booklet of 40 pages including suggested electrical specifications for code ringing, pre-signal, master-code, and continuous ringing fire alarm systems. Done in a loose leaf binder booklet contains descriptions of equipment offered by this firm and explains how the fire alarm system is tied into the regular paging system. Wiring diagrams are shown for systems. Equipment listed and described is: fire alarm boxes, fire alarm signals, punch and printing recorders. Signals such as bells, horns and whistles are detailed and the code transmitter operation is explained. The Autocall Company.

29 **Tachometers**—Direct reading tachoscopes are described with illustrations and a list of the types offered. Explanation of how these instruments may be used to determine the cutting speeds of machines. No stop watch is needed with these instruments. Pocket size, these models may be carried about easily. Improved model can be used for speed indicator, cutmeter, calibration check for tachometers, or a stop watch. O. Zernickow Co.

30 **Instruction Manual on Ohmmeter**—Manual 24J25 is for use with this firm's low resistance ohmeter. Booklet of 47 pages of solid information on how to use the instrument, and how it may be used on equipment to be tested. 21 illustrations; pictures, curve charts, line drawings, tables, showing how the instrument may be applied, how it works, ranges applicable to, and the instrument itself with the power supplies it can use. Formulas for use with various hookup connections, and for figuring corrections for temp. James G. Biddle Co.

31 **Liquid Level Controls**—A 4 page bulletin describing the principle and operation of the relays made by this firm, for application to general purpose pumps, condensate return pumps, deep well cutoffs and pumps, acid pumps, sewage pumps, high and low water cutoff and signals. Pictured with explanations are the induction relays, induction relay switches, relay and starter combinations, multiple pump controls, electrode holders and special controls and panels. B/W Controller Corporation.

32 **Vibrators & Maintenance Tools**—New, complete 92 page catalog illustrated and describing: electromagnetic vibrators, packers, vibratory feeders, dry feeder machines, weighing feeders, vibrating grizzlies, vibrating lawns, paper joggers, hopper level switches, explosion-proof hydraulically operated feeders, vibrators, jolters, and mechanical shaft seals. Construction and maintenance tools are treated in the same manner and include: self-contained gasoline hammer paving breakers, portable electric hammers, drills, grinders, sanders, electromagnetic form vibrators and flexible shaft mass concrete vibrators. Line drawings are used throughout with application photos to show how the equipment works and where it may be applied. Syntron Company.

33 **Electric Soldering Irons**—The irons made by this firm are listed with a description of their capacity, size, components, suitable applications, and auxiliary equipment. Regulating stands, copper tips, and melting cups or ladles are also shown. American Electrical Heater Co.

34 **Power-actuated Hand Tool**—A 6 page folder describing the models of hand tools made by this company that utilize the exploding fastener, for many kinds of work. Illustrations and step-by-step photos show how the tool is used and how it is constructed. Various uses to which it may be put are listed as: hanging piping systems, attachments to structural steel or concrete, installing air conditioning equipment, plant maintenance. Three power loads available and different drive pin and stud sizes are listed. Tempo Products Company.

MISCELLANEOUS

35 **Sprinkler Fire Protection**—The effective planning of location of nozzles on sprinkler systems is carried throughout this book, Bulletin No. 64, of 28 pages. Profusely illustrated with line drawings, artist's conceptions, actual applications, and photos of the actual equipment. In most of the application pictures the positioning of the nozzles has been touched up so that the angle can easily be seen. These describe this complete system of fire protection and the components that make up the whole. Proper location of the heat detectors is discussed and shown. "Automatic" Sprinkler Corporation of America.

36 **Gas Mask Equipment**—As a practical help to all users of gas mask equipment, this series of 5 bulletins presents a wide range of protection equipment for use in hazardous gas and smoke atmosphere. Information is given on the line of full-vision gas masks and canisters, and proper canisters to use for smoke, fumes, mists, organic vapors, acid gases, ammonia, etc., are noted in a table which provides a long list of gases together with equipment recommended. One of the bulletins shows method of determining concentration of gases. Acme Protection Equipment Co.

37 **Selecting An Air Compressor**—In this 12 page bulletin of heavy stock are all the tables, charts, and examples, needed to select an automotive air compressor. Book is nothing but information. Tables on, requirements of equipment, cylinder dia to overcome load, volumes of air for applications, flow of free air through orifices, wire size, pipe size, and efficiency in cu ft per kw are provided to aid in the selection of a compressor. Also included are installation and maintenance instructions. Pneumatic Automotive Equipment Assn.

38 **Lubricators and Fittings**—Bulletin No. 16 is this firm's catalog on their sight feed valves, multiple oilers, flow indicators, sight overflows and compression union fittings. Specifications, line drawings, dimensional drawings, equipment photos, a table of losses due to small leaks from minutes to a month is provided. Wm. W. Nugent & Co., Inc.

39 **Floor Gratings**—This 8 page bulletin on welded floor grating contains general engineering data on this subject as applied to standard and close spaced grating. Line drawing depicts methods of fastening gratings. A table of safe loads on grated floors is a feature. Application photos show typical uses grating may serve. Kerrigan Iron Works, Inc.

40 **Asbestos Textiles**—The specifications and characteristics of various asbestos textile materials. This 16 page bulletin tells how the materials are made for the many different uses. The kind of weave used and the weight desired for various purposes are given. This applies to cloths, tubing, cord, wicks, rope, and lap. Johns-Manville.

41 **Drying Agents**—A line of these drying agents for industry is described in this 4-page bulletin. The various types of agents are explained together with their properties, efficiency and capacity. The applications in refrigerant drying, organic liquids, packaging hygroscopic materials, preparing dehydrated products, telephone cable splices, tank breathers, etc., are fully described. The forms that the agent takes is indicated. Industrial tower dryers are also described, including information on the calculation of tower size, cooling requirements, regeneration and drying of organic liquids. W. A. Hammond Drierite Co.

MECHANICAL POWER TRANSMISSION

42 **Multi-cord Belting**—This is a catalog section describing the belting put out by this firm for severe drives, heavy loads, high speeds, small pulleys, and limited takeup. The construction is explained as are the sizes available and the speeds to which they are suitable. B. F. Goodrich Co.

43 **Flexible Coupling Bulletin**—Typical installation photos show the application of this firm's flexible couplings to a variety of equipment. Dimension drawings, ratings, size listings, and list of applications possible are given. John Waldron Corp.

44 **Preventing Reverse Rotation**—Bulletin 10,080 illuustrates and describes the construction and operation of the back-stop to prevent dangerous reverse rotation of conveyors, elevators, windlasses, winches, and all other applications where reverse rotation is dangerous. The bulletin contains specifications, and mounting dimensions. An exploded view shows how the unit functions. The Falk Corp.

45 **Speed Reducers**—Complete engineering data is given on this line of speed reducers in 4-page Bulletin 118. Shown are the dimensions of small type D double reduction unit and the dimensions of large type D double reduction units. The standard dimensions are indicated in inches, and the general specifications are explained. Cleveland Worm & Gear Co.

46 **Flexible Coupling Application**—This new, 8 page book presents a story of flexible couplings; their design, application, selection and prices. For clarification cutaway, exploded photos and drawings are used. Diagrams of types of shaft misalignment are shown, and charts make the selection and ordering easy. Chain Belt Co.

47 **Functions of Flexible Couplings**—A thorough explanation and analysis is given in this booklet, of 24 pages, to the principles by which couplings operate and their importance in relationship to the equipment it connects. Presents practical helps to plant engineers, mechanics, and maintenance men on how the use of flexible couplings prevents downtime caused by bearing failure, shaft failure and damaged equipment. Description and illustrations show how the operation of a flexible coupling compensates for end thrust and the three types of shaft misalignment. Also describes maintenance of coupling and renewal of wearing surfaces. American Flexible Coupling Company.

HOISTS

48 **Hoists**—Complete specifications and prices are included in this 10-page Bulletin 138-E describing a line of hoists. Drawings indicate the specifications. The hoists are shown to include units from 250 to 2000 lb. Chrisholm-Moore Hoist Corp.

49 **Steel Hoist**—Bulletin No. 800 contains 4 pages of valuable information on this line of 1000 and 2000 lb hoists. Complete ratings and clearance dimensions are given. Specifications of the various sections of the hoists are described and illustrated. The motor driven trolleys are amply explained. Robbins & Myers, Inc.

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When turbine oil is changed, the new turbine oil has a detergent action. It picks up deposits of sludge and sediment that may have settled out from the old oil in the turbine reservoir and piping. The best way to prevent damage by this picked-up material is to remove it from the oil by centrifugal force before it can circulate through the system.

A De Laval Oil Purifier is the most foolproof way of keeping turbine lubricating oil clean. In the bowl, or purifying member, both the solid impurities and any moisture that may get into the oil are instantaneously separated out. Removed water is discharged continuously, and dirt is stored in the bowl, out of the zone where purification takes place.

Action of the De Laval machine is wholly mechanical — De Laval Purifiers do not remove the valuable inhibiting agents added by the refiners.

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LUBRICATING OIL PURIFIERS

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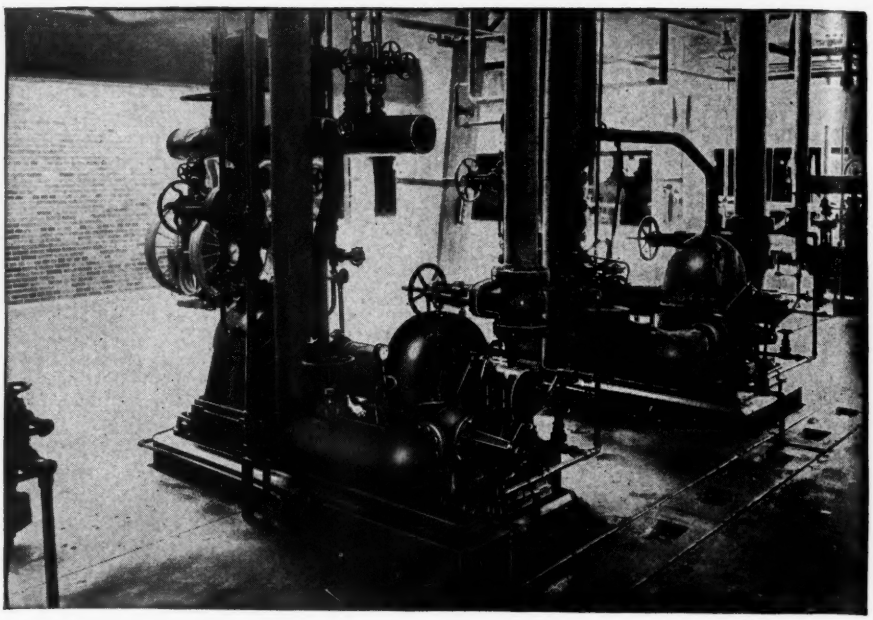


THE ROTORS OF THESE 75 H. P. TERRY TURBINES ARE DOUBLE RIM PROTECTED

The two 75 H.P. Terry Turbines shown above (in the plant of a leading refiner) employ the Terry Solid Wheel Rotor. The wheel is made from a single steel forging and the buckets are milled directly into the wheel. — All as shown in the illustration at the left.

The buckets are protected by rims at the sides of the wheel. These rims would take without damage any rubbing that might occur if the clearance became reduced.

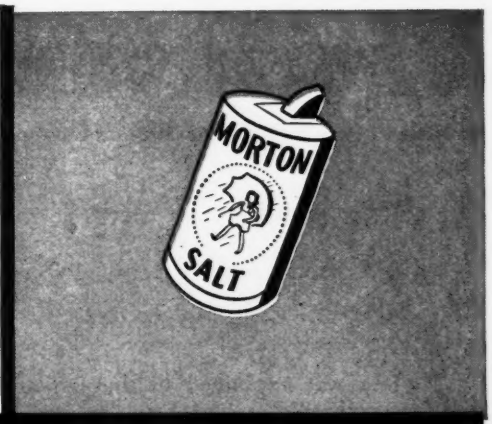
With this construction it is impossible for the blades to foul and frequent inspections of the thrust bearing are not required to obtain safe and dependable operation.

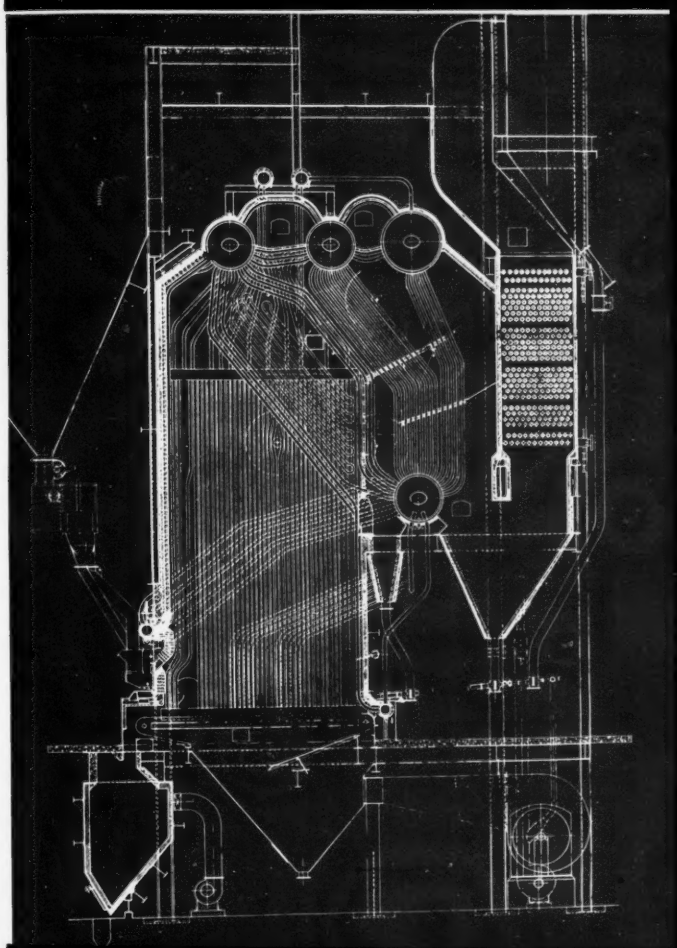
This feature and many others of the Terry Wheel Turbine are fully discussed in our Bulletin S-116.

T-1169

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

Another WICKES BOILER for Morton Salt Company





When engineers of the Morton Salt Company specified a Wickes 4-Drum Boiler for the Morton plant at Manistee, Michigan, their choice was dictated in part by proven Wickes performance. For this is the *second Wickes boiler* installed at Morton's Manistee plant—evidence that *Wickes design and construction delivers the efficiency* that industry demands of a power generating unit. Cummins & Barnard, Inc., Engineers, of Ann Arbor, Michigan were consulting engineers on this installation. Specifications include: 180,000# steam per hour capacity, design pressure 700 psi, and total temperature 750° F. The advantages of Wickes 4-Drum Boiler design are readily apparent. Large diameter drums, minimum number of tube bends, and steam liberating area large enough to insure *rapid response to load changes.* For boilers of any type with capacities up to 250,000 lb. steam per hour and 850 psi, *consult Wickes first.* We are completely equipped to design and build boilers to specific requirements.

THE WICKES BOILER CO.

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

SALES OFFICES: Atlanta • Boston • Charlotte, N. C. • Chicago • Cincinnati • Denver • Detroit • Houston • Indianapolis • Kansas City • Los Angeles • Milwaukee • New York City • Peoria, Ill. • Pittsburgh • Saginaw • San Francisco • San Jose, Calif. • Seattle • St. Louis • Tulsa, Oklahoma • Mexico City, Mexico.

RECOGNIZED QUALITY SINCE 1854

Here are Facts about the Editorial Conte nd

In January the name of POWER PLANT ENGINEERING was changed to POWER GENERATION.

As was explained in the January issue, this change in name implies no change whatever in the character or editorial content of the magazine.

POWER GENERATION will continue to cover the same subjects that POWER PLANT ENGINEERING has covered in the past.

Nothing has been changed but the name. That change was made to avoid confusion with our new publication, PLANT ENGINEERING.

Under its new name POWER GENERATION, the magazine will concern itself not only with the problems of power "generation," but also with problems of power "transmission and distribution," "application," "service and maintenance" as these problems apply to the daily job of a power engineer, whether this power engineer's interests are in an industrial, utility or service establishment.

POWER GENERATION will continue, as always, to devote itself to the entire field of power plant engineering. This involves the theory, design, construction, operation and maintenance of all kinds and sizes of power plants. It includes steam, electric, Diesel, hydroelectric and other forms of power supply.

The PRACTICAL ENGINEER section has been retained. It emphasizes the power operating problems of the power engineer, whether his *title* be power engineer, operating engineer or power superintendent.

Steam, water, compressed air, and other *power plant* services for process and heating together with refrigeration and air conditioning will receive continued editorial attention.

In short, POWER GENERATION is merely POWER PLANT ENGINEERING with a new name.

To show that the change in name *has not* changed the magazine, we present a comparison of the first three issues of POWER GENERATION in 1948 with the first three issues of POWER PLANT ENGINEERING in 1947, broken down by subject matter covered. See next page.

te nd Coverage of POWER GENERATION

POWER PLANT ENGINEERING Jan., Feb., March 1947	% of Editorial Content
Generation	22 %
Transmission and Distribution	7.7%
Application as it Affects Supply	16.3%
Service and Maintenance	20 %
Miscellaneous	34.0%
Total	100.0%

POWER GENERATION Jan., Feb., March 1948	% of Editorial Content
Generation	20.5%
Transmission and Distribution	10.3%
Application as it Affects Supply	16.2%
Service and Maintenance	21.6%
Miscellaneous	31.4%
Total	100.0%

Circulationwise, too, the magazine is virtually unchanged. Likewise what change there was is a *plus* not a minus value for advertisers. Under our new circulation plan it was possible to eliminate what few fringe readers there were—*these totaled less than 10%*—and replace them with readers more specifically interested in the editorial and product information carried by the magazine. Herewith are the circulation *facts:*

ABC Statement June 30, 1947, Total Net Paid	21,736
Total Circulation January 1948	21,862

The reason POWER PLANT ENGINEERING has for 51 years been such an outstanding *value* for readers and advertisers alike is because its editors have *constantly* striven to penetrate more deeply into the problems of being a power engineer—the power engineer being the reader we serve. We could *dilute* his interest in us by adding extraneous material in an effort to attract more fringe readers. This policy we reject as being unsound from our viewpoint and uneconomic from the advertiser's point of view.

Andrew C. Kramer

Editor

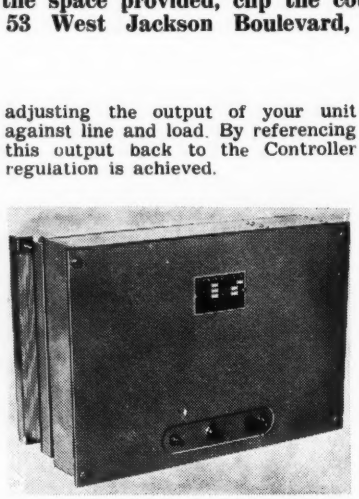
NEW EQUIPMENT NEWS

Use the coupon below when you want further information on the equipment described on this page and following pages. Write the identifying letter or letters in the space provided, clip the coupon and send it to Power Generation, 53 West Jackson Boulevard, Chicago 4, Illinois

A Quartzoid Ceiling Sprinkler. Nothing but the deflector supported by its arms and the attractive Quartzoid bulb show below the smooth level of the ceiling on this new sprinkler. The narrow ring which closes the opening through the plaster can be brushed, chrome finished or painted to be indistinguishable from the rest of the ceiling surface, although in many locations its normal appearance will be decorative rather than objectionable

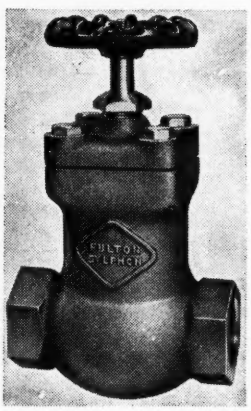
Should fire occur, the improved distribution provided by the new deflector assures maximum effectiveness from the first sprinkler and many others opened by a starting fire. Temperature at the ceiling over a starting fire only has to reach 135F to burst the Quartzoid bulb, release the water, and begin extinguishing the fire. Grinnell Co., Inc.

B Automatic Voltage Regulator. Called the Controller, this unit is said to permit selective stabilization of a c, d c or r f outputs in any one circuit over wide ranges of line and load. The a c output of the Controller swings between 85 and 145 vac, automatically adjusting the output of your unit against line and load. By referencing this output back to the Controller regulation is achieved.



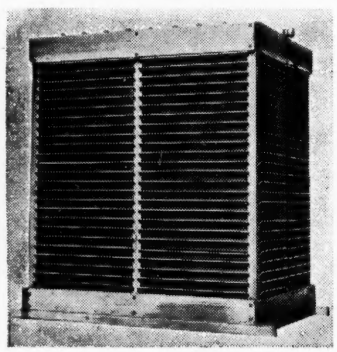
The Controller provides stabilization at the point requiring regulation. At least one watt of power must be made available to the Controller bridge circuit In a d c application at least 0.4 amp must be made available from the rectifier filter circuit. It weighs approximately 100 lb and is available for relay rack mounting. It is fully protected against over-load and over voltage Gray or black wrinkle are the choice of finishes. Sorenson & Co., Inc.

C Leakproof Packless Valve. This new valve, termed the No 3000 series, owes its leakproof performance to the seamless metal sylphon bellows which forms a leakless connection between the valve disc and the valve body. This construction enables repeated opening and closing of the valve and no maintenance is required to keep the stem absolutely tight against leakage, even under extreme conditions of pressure or vacuum. A new feature is the fact that they are available equipped with stainless steel bellows and stainless steel bodies. In the screwed-end type, the new valves are applicable to temperature services up to 300F. For service with temperatures above 300F and up to 700F, a yoke and external thread (O.S. and Y.) construction is employed. By special construction these valves may be made suitable for ex



treme temperatures up to 1200F. The valves are made in sizes ¼ in. up to 3 in. with screwed, welded or flanged ends. Fulton Sylphon Div., Robertshaw-Fulton Controls Co.

D Small Cooling Tower. A small natural draft cooling tower that embodies the engineering design, balanced spray system and predetermined performance only previously available in large towers, is the new Series 100 tower. Several



new features that were incorporated in the design are: Lumber of heart redwood. Machined louver posts

MAY, 1948

POWER GENERATION
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Chicago 4, Illinois

Please have the manufacturers send me without obligation further information on the equipment indicated by the following letters:

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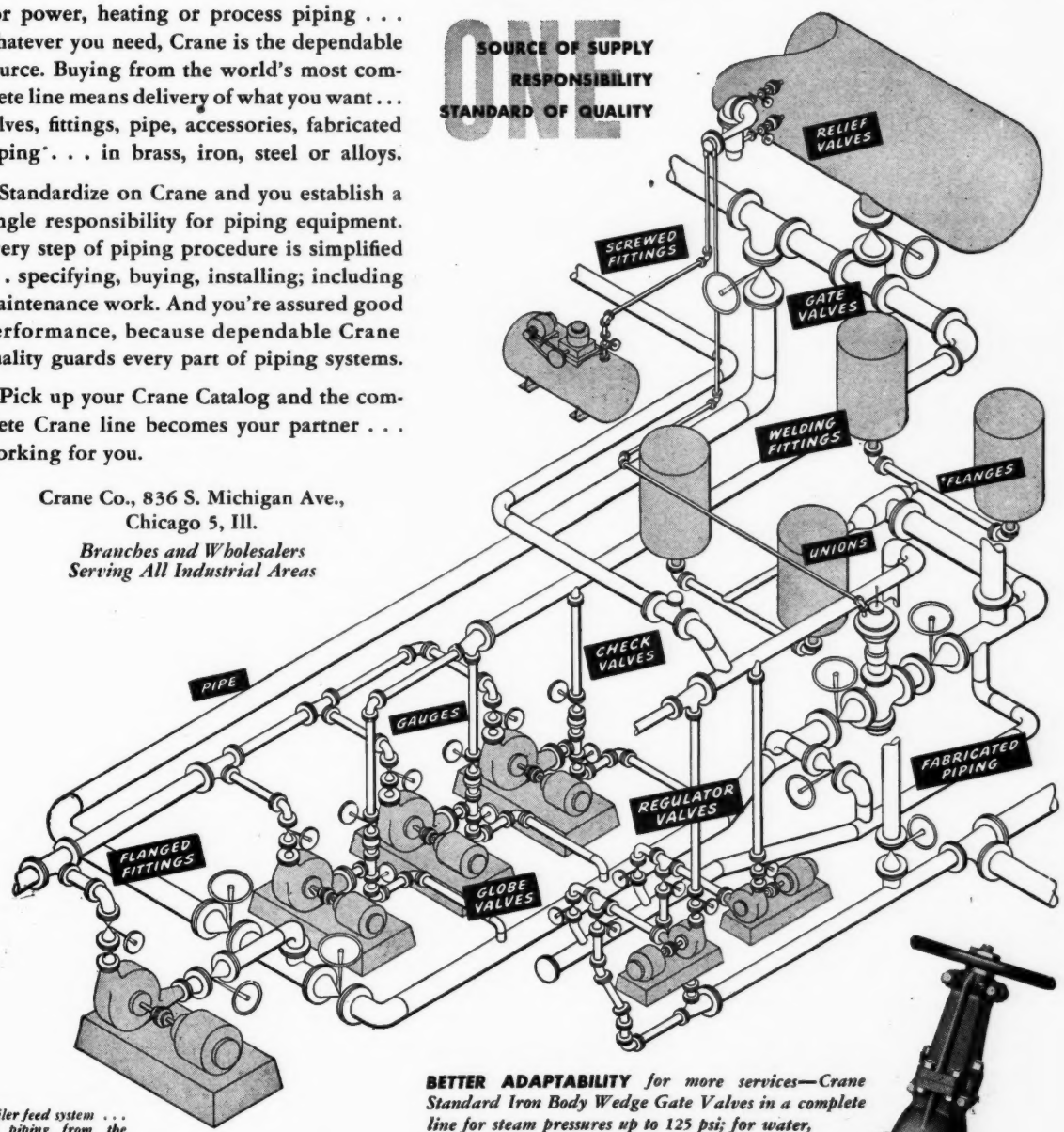

Boiler feed system . . . all piping from the complete Crane line.

BETTER ADAPTABILITY *for more services—Crane Standard Iron Body Wedge Gate Valves in a complete line for steam pressures up to 125 psi; for water, oil or gas up to 200 psi. Made in outside screw and yoke, and non-rising stem patterns; screwed or flanged ends; brass-trimmed or all-iron. In sizes 2 in. and larger. See your Crane Catalog, pp 101-6.*

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VALVES • FITTINGS
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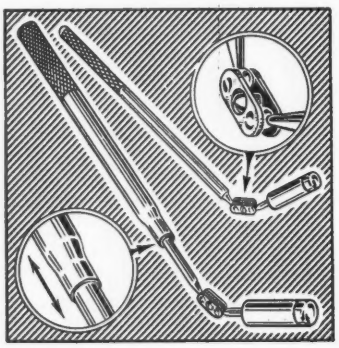
FOR EVERY PIPING SYSTEM

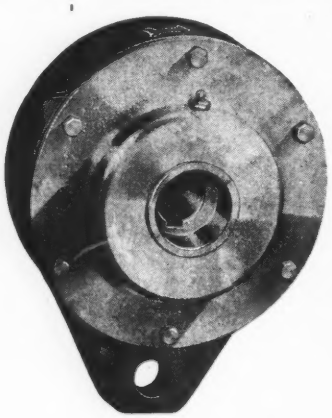
without any troublesome nails, bolts, or backup strips. Louvers are slip-fit and are readily removable for inspection. Frame and girts are bolted two ways to give maximum strength. Spray system designed to give maximum breakup at lowest pressure and to give a balanced spray in all areas in the tower. Basin complete with wooden walls and heavy steel basin complete with automatic float valve and non-cavitating cast iron suction. Six frame sizes to give from 4 to 36 tons' refrigeration. The Marley Co., Inc.

E Did you drop a nut? New magnetic tools have been designed to find small parts inexpensively and quickly. Magimmicks are of the all angle ball joint type, the magnetic section will stay put at any angle and retrieve the lost parts.



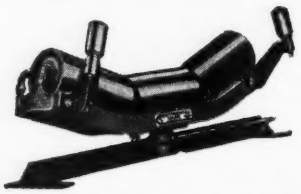
Magimmick Sr. is of the telescopic type ½ in. dia and will open to 26 in. Magimmick Jr. is 5/16 dia by 8-3/8 in. long. Ullman Products Corp.

F Backstop Prevents Reverse Rotation. The new Backstop provides a positive method for preventing reverse rotation on conveyor drives, elevator head



shafts, windlasses, winches. Back-run or reverse rotation in some machinery operations, may cause serious damage to the machinery and the material being handled. In addition, expensive production delays may result. The gripping action of the backstop takes place at the precise moment that forward rotation ceases. It reduces the possibility of shock or strain to a minimum. The Falk Corp.

G Self-Aligning Idler. A new, patented, self-aligning belt conveyor idler, said to be a distinct improvement over existing types, has just been announced. It is

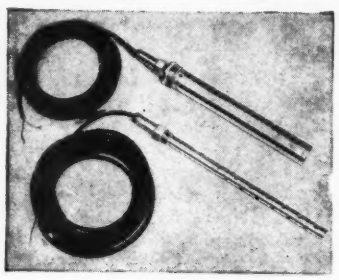


made in designs suitable for troughed, flat and return belts, and the units are interchangeable with standard idlers. Construction features include heavy duty Timken Bearings on the 1¼ in. swivel shaft; all grease pipes extended to one side for ease and safety of lubrication; hydraulic fittings as standard equipment, with others offered if required. The manufacturer states that it is not necessary to cut into the deck plate to mount the troughing idlers. Industrial Division, Continental Gin Co.

H Extra Strength V-Belt. A nylon-reinforced V-belt with twice the strength and four times the average life of conventional V-belts has been developed. The belt contains a series of tough nylon cords covered with a special synthetic rubber compound capable of withstanding the deteriorating effects of heat and oil, states the maker.

The belt is particularly recommended for power transmission on equipment subject to rough usage. In addition to high tensile strength, it has flexibility and a sufficient elasticity to absorb shock. It will be named U S. Royal Super Service V-Belt. United States Rubber Co.

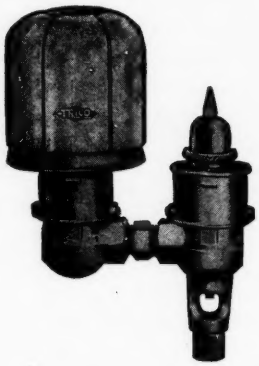
I Conductivity Measuring Cells. For continuous recording or for automatic control systems where temperature



variations of the electrolyte make conductivity measurement difficult, a combination of sturdy measuring and pre-filled reference conductivity cells provide for automatic temperature compensation. Heavy walled Pyrex construction and complete protection by Type 316 stainless steel sheaths, cells are designed for industrial service. They have standard pipe thread fittings. Operating conditions may include corrosive solutions, temperatures up to 150C and pressures up to 50 psi. Industrial Instruments, Inc.

J Gravity Feed Oiler. A new precision oiler for solid bearings where an accurate rate of feed and clean, filtered oil are essential. It is said to maintain an accurate constant level in the gravity feed mechanism. Dust or dirt cannot reach the bearing or clog the needle valve as oil is thoroughly filtered through the patented removable filter.

The oiler is mounted at the top of the part to be lubricated and any



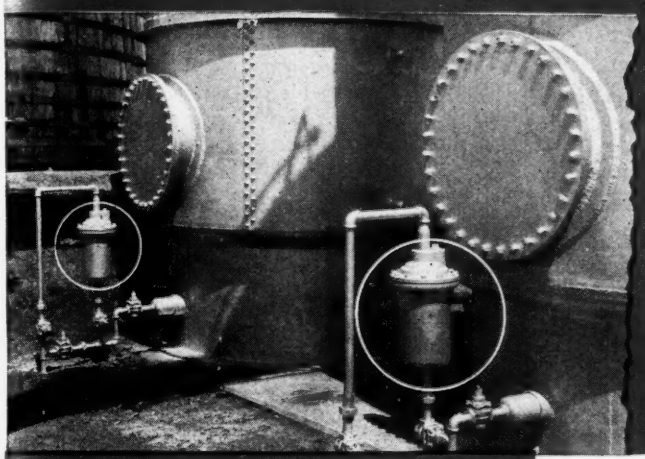
predetermined number of drops of oil can be obtained by a simple adjustment of the needle valve. After the desired adjustment is made, no further attention is required except to keep a reserve supply of oil in the large capacity bottle. The shutoff lever, when in a vertical position, feeds oil when tilted to the side, stops the flow and, when held at 45 deg, it flushes the bearing which is desirable before starting machine. Trico Fuse Mfg. Co.

K Float-Sink Concentrator. The float-sink concentrator consists essentially of a drum-shaped tank to contain the liquid medium and the rotating elevator with perforated lifter shelves that deliver the sink material to a flume. The feed enters through a flume and is immersed in a bath of medium inside the Float-Sink Concentrator. The float material rises and promptly passes over a discharge wier and a stationary seive on which the medium is drained from the solids. The sink material is elevated from bottom of tank by means of the rotating wheel to a flume, from which it passes to screen.

These products now pass under water sprays and over drain, rinse and de-watering screen of vibrating type. Practically all the medium is recovered through the stationary sieve, passed to a sump, and from there re-circulated through a pump to the float-sink concentrator. The piping arrangement provides for a portion of the medium to enter the concentrator directly. The remainder is used for fluming feed coal into the vessel and reject material from the vessel. Any particles of magnetite

Dirt Doesn't Hurt

AN ARMSTRONG TRAP



- Less Maintenance
- Longer Life
- Better Drainage
- Greater Dependability
- Less Steam Loss

because...

Swirls Through!

The Dirt

Send for the Armstrong Steam Trap Book — it's a practical guide to better trapping. Facts, figures and diagrams on trap selection, capacities, prices, installation and maintenance.

NO ONE wants equipment that has to be babied. A steam trap that won't handle ordinary dirt and scale means a lot of work for the maintenance crew. If it clogs up it may not discharge condensate —a pretty note if it's on a critical application. Or it may stick open and waste a lot of steam—until somebody comes along and discovers it.

With Armstrong Traps you don't have these problems. There are no dead spots in which dirt can collect. There are no close-fitting parts to clog up or stick. The discharge orifice is nice and big, it can't foul up*. No dirt can lodge on the valve or seat to prevent steam-tight closing. You don't have to baby Armstrong traps — they seldom need attention.

Where dependable service counts, it pays to buy ARMSTRONG.

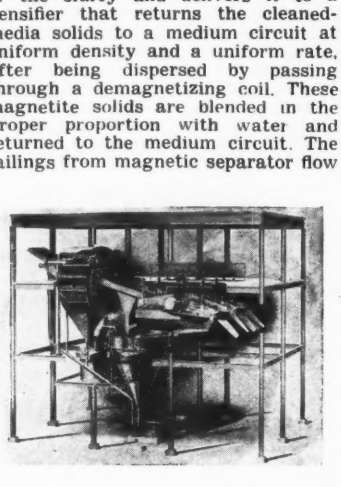
ARMSTRONG MACHINE WORKS
810 Maple St., Three Rivers, Mich.

*Armstrong won't build its little No. 800 trap for pressures above 125 psi. because it would necessitate too small a discharge orifice. Who wants a trap with an orifice which might plug up with dirt?

ARMSTRONG *Inverted Bucket* **STEAM TRAPS**

Over a Million in Use...For Power...Process...Heating

adhering to the solids after passing beyond the draining zones are rinsed off on the respective vibrating screens, and are deliverd to a thickener, preceded by a magnetizing block which augments the set tling of the magnetite by magnetic flocculation. The heavy particles settling out of thickener are pumped to a magnetic separator, which lifts the magnetite out of the slurry and delivers it to a densifier that returns the cleaned-media solids to a medium circuit at uniform density and a uniform rate, after being dispersed by passing through a demagnetizing coil. These magnetite solids are blended in the proper proportion with water and returned to the medium circuit. The tailings from magnetic separator flow

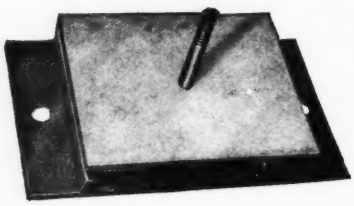


direct to the final water clarification system, into which also passes the overflow water from primary thickener. The clarified water returns in closed circuit for re-use as sprays over screens, separators, etc. Link-Belt Co.

L Reversing Superstructure Diaphragm Valve. A new reversing superstructure for use on diaphragm regulating valves, has just been introduced.

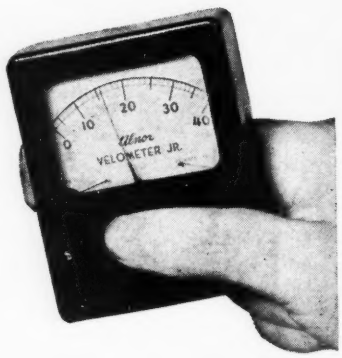
This new superstructure permits the reversing of the valve action by simple substitution for the standard superstructure. There is no need to remove the valve body from the line. The maker states it was important to duplicate the performance of the standard superstructure in every way. Therefore, the same characteristic valve action is maintained when changing from one superstructure to another, including minimum hysterisis, the same effective diaphragm area and spring characteristic as the standard. The protective diaphragm cover is designed to provide safety and prevent tampering. Price $12.00. Leslie Co.

M Vibration Mounts. The CM series of vibration dampers includes two types of mounts: CM-H for horizontal and ro-



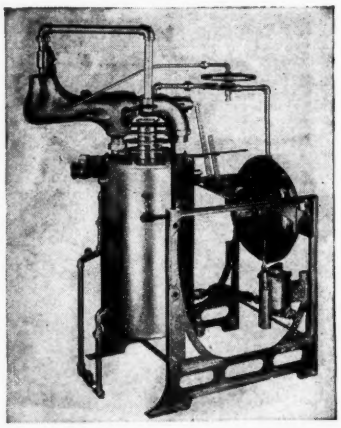
tary vibration and CM-V for vertical vibration in top heavy and recoil type machines. Both these mounts attain maximum efficiency through the principle of rubber-in-shear and their non-overloading characteristics. The design of CM Mounts involves no rubber-to-metal bonds that may break or separate in use. High grade synthetic rubber inserts are held firmly in place by steel retaining brackets and are impervious to oil, water, sunlight, grease and cleaning solvents. The virtually indestructible features of CM Finnflex mounts permits their use under almost any condition. Finn & Co.

N Miniature Velometer. This palm-sized Velometer Jr., does not require jet attachments.



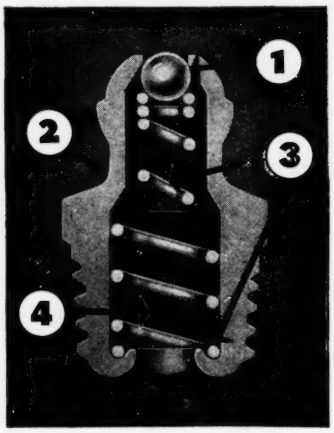
Completely self-contained, it is 4 in. high, 3 in. wide, 1½ in. deep—weighs only 8 oz and has single or double velocity range scales. It is calibrated to provide direct reading of air velocity in either fpm or mph without timing, calculations or reference to tables and charts. Movement is double-pivoted, double-jeweled for increased accuracy. The air actuated pointer vane and sensitive controlling hair springs are protected by a sturdy molded bakelite case. Illinois Testing Laboratories, Inc.

O Industrial Gas Generators. A compact unit for producing safe, low-cost gas from fuel oil for all types of industrial ovens and furnaces is the Vapofier, extensively used as a gas "standby" because of its quick switchover to gas without interruption of flame or change of flame quality. Now used in many industries, it automatically



maintains constant manifold pressure and air-gas ratios from a reducing to an oxidizing flame. Gas produced has low hydrogen content which means less scale on ferrous work. Vapofier Corp.

P Bullneck Type Grease Fittings. These bullneck type grease fittings incorporate the most desirable characteristics of former types of high-pressure fittings



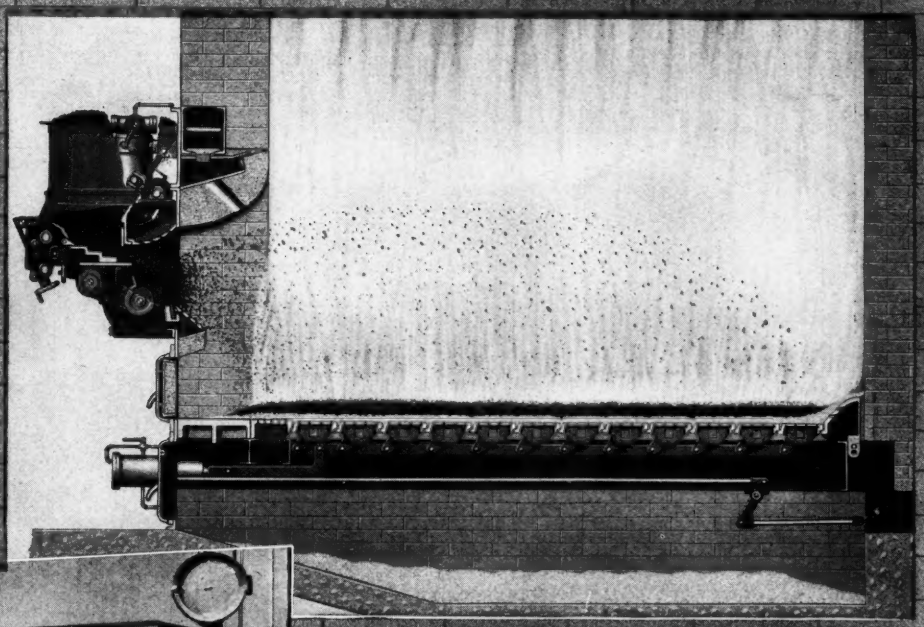
and permit standardization on one, all-purpose fitting. They represent a major improvement in grease fitting design that does not obsolete couplers and grease guns in general use today—they can be securely contacted by all commercial hydraulic couplers. Lincoln Engineering Co.

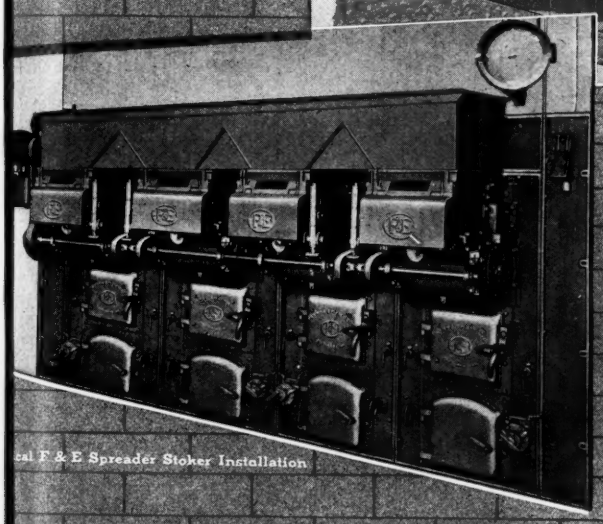
Q Aluminum-Enclosed Bus Run. A new aluminum-enclosed isolated-phase bus run for safely interconnecting generators, transformers, and switch-gear equipments has been announced. The equipment is available for 15 kv applications in current ratings of 1200, 2000, 3000, 4000, and 5000 amp, and has a basic impulse level of 110 kv. It is dust-tight and weathertight, and may be used for indoor or outdoor installa-

SPREADER F&E STOKER

Electro-Hydraulic Drive

With improved mechani- features for greater pendability and high ficiency, the *new* "F & E" preader Stoker insures de- ndable, economical per- rmance. For over 30 years, name Flynn and Emrich been the symbol for the t in stoker equipment. hether your problem is tallation of a new stoker a conversion from your sent fuel burning equip- nt, it will pay to specify & E." Write for illus- ated Bulletin No. 1301.





cal F & E Spreader Stoker Installation

GRATES—sectional in design, mounted on heavy steel supports. Deep cooling fins beneath the ash protection grooves on top, assure long life.

"F & E" AIR-COOLED IGNITION ARCH—integral part of the "F & E" Spreader Stoker.

ELECTRO-HYDRAULIC DRIVE — the most advanced spreader stoker drive. Minimum of working parts all operating in a bath of oil. No shear pins or other safety devices required. Lends itself perfectly to automatic control. Unlimited number of feeds.

"F & E" INCREMENTAL HYDRAULIC CONTROL VALVE—regulates the operation of the electro-hydraulic drive either automatically or manually.

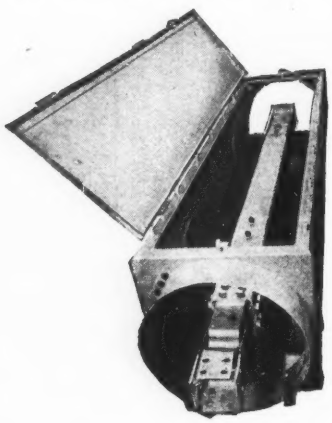
COAL FEED PUSHERS—sectional in design, alternate in movement, insures dependable continuous feed.

ONE MOTOR DRIVE—one electric motor supplies hydraulic reciprocating power for coal feed pushers as well as rotating power for coal distributors—all in one compact assembly.

FLYNN & EMRICH COMPANY ESTABLISHED 1842

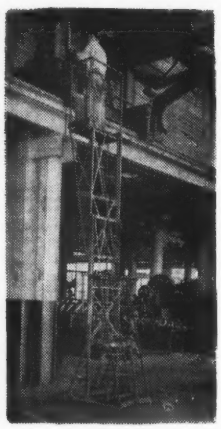
HOLLIDAY & SARATOGA STS. BALTIMORE 2, MARYLAND

tions. It is tested and assembled to meet AIEE and NEMA standards. Each phase of the bus run has a single aluminum sheet shaped to form three sides of the housing. The fourth side consists of a gasketed and clamped cover which is hinged to avoid the necessity of handling loose covers when inspecting the bus. End bells of adjacent sections are connected by split aluminum bands having gasketed



mating flanges. To form a length of three-phase bus run, three housings are bolted to cross members made from aluminum H-beams. The steel plate brackets supporting the insulators are braced apart by these same cross members. Necessary structural steel members for attaching the H-beams to the building structure are supplied. General Electric Co.

R Hi Reach Telescoping Platform. When in normal position this platform is only 6 ft 8 in. high but it will extend to 15 ft. Hand powered windlass and with wheels for



easy handling about the plant this platform is handy for maintenance. The holding capacity of the platform extended is 300 lb and the dimensions of the platform are 20 by 30 in. The load can automatically be held at any height. Three models are offered, priced from $280 to $315. Heights of 20, 25, and 30 ft can also be had. Economy Engineering Co.

S Heavy Duty Lube Oil. A new fully detergent and fully dispersive heavy duty oil is announced. Refined from 100 per cent pure Pennsylvania crude, the new oil will be under the trade name of Colonel Drake Heavy Duty Oil. It is said to be specially compounded for Diesel and gasoline engines in heavy duty service. Foaming, even under the most severe temperatures and operations, is prevented by chemical additives. Sludge and soot particles are kept in constant suspension so that they drain off during oil changes. According to the refiner, ring sticking and bearing troubles are eliminated. Low pour point assures minimum drag and easy starting in even the coldest weather. High viscosity index means less thinning out at high operating temperatures. Colonel Drake is also reported to be non-corrosive and safeguards copper-lead and other alloy bearings. Pennsylvania Refining Co.

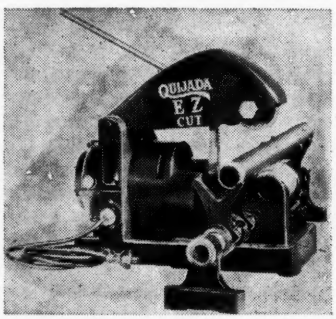
T Chemical Feeder. A new liquid chemical feeder with several advances over previous designs of feeding devices has just been developed. Known as the Decantrol, it is used to feed chemicals either in solution or in suspension form to

water that is to be chemically treated for softening or clarification. In this service, the unit is equally adapted to either constant rate or proportionating rate control systems of chemical feed.

The Decantrol is a totally-enclosed motor-operated gear-reduction unit of special design, and is mounted on the top of a chemical feed tank. A feeding sprocket engages with a chain, one end of which is connected to the drawoff head of a decanting pipe. The other end of the chain is connected to a level-position indicator which rises as the decanting pipe is lowered. Liquid Conditioning Corp.

U Chemical Cleaner and Deodorizer. A new chemical material possessing the dual ability to clean and deodorize in a single, simultaneous operation has been recently announced. Di-Sanite, is a fine, free-flowing powder, mildly alkaline, that is readily soluble in hot or cold water, and which is said to possess pronounced wetting, penetrating and detergent ability, as well as deodorizing action. The manufacturer states that the material is safe to use, free from abrasives and harmful ingredients, and its solutions may easily be applied on surfaces by simple sponging, wiping or mopping. Suitable for use in practically every industry, it is highly effective in destroying objectionable odors at the source in factories, metal plants, textile and paper mills, food plants, institutions; for deodorizing toilets, shower stalls, and wash and locker rooms. Oakite Products, Inc.

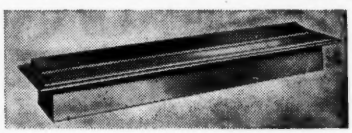
V Pipe and Tubing Cutter. Power-driven rollers, automatic stop-start action and ball-bearing operation throughout are unique features of the new high speed



E-Z cut pipe and tube cutter. Compact in design, this fully portable machine simplifies and speeds up pipe and tube cutting operations in pipe diameters ranging from ⅜ to 4 in. Cutting cast iron pipe within the same range is also possible with this new cutter. An internally-mounted ½ hp, 110 v, universal type a c - d c motor furnishes direct gear drive to the rollers. Gears are self-lubricating. An automatic trip-switch starts cutting operations when the cutter wheel contacts the pipe and automatically stops when the cut is finished. Adjustable roller yokes provide necessary support for the pipe, yet permit free rotation. Quijada Tool Co., Inc.

W Fuel Oil Cleaner. A new fuel oil additive, designed to clean oil systems from tank to stack, passes all rigid requirements for plant use. Its main features are that it is safe to use and store and is not toxic, is non-corrosive and will not harm metals or working parts of the heating system, and also stops formation of soot which insulates boiler surfaces and cuts down heat values. It is added directly to the fuel tank in the ratio of one qt to 1,000 gal of fuel oil. E. F. Houghton & Co.

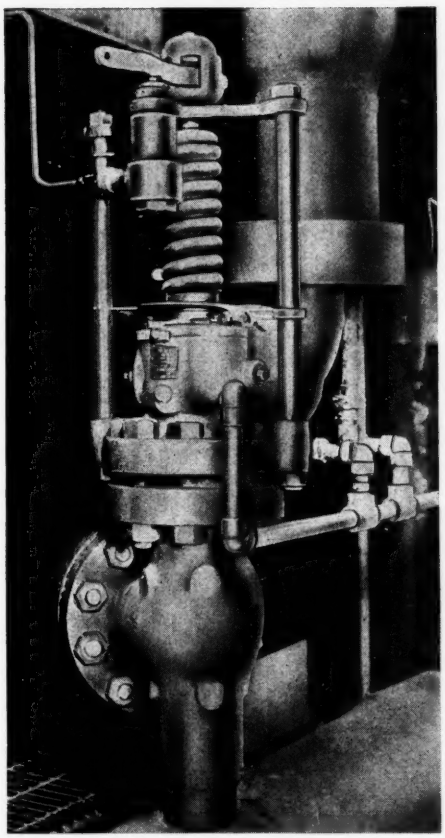
X Non-Electric Magnetic Separator. Permanent non-electric magnetic separator adaptable for general use in the power



field. Newly designed Alnico castings provide a constant magnetic field which will remove tramp iron from heavy free flowing material. The effective cleaning range varies depending upon the size of material. Special face

Give Your Boilers a Break!

End Safety Valve Troubles by Installing FOSTER 38-SV Safety Valves with these 5 GUARANTEED ADVANTAGES:



Hundreds of Foster 38-SV Safety Valves are giving top performance in important installations. This 2½" superheater unloading valve operates at 1450 lb., 950° total temp. Others are in service up to 2575 lb. at 1000° F.

1 Built to Stay on the Job—the Foster 38-SV is the SAFETY valve that is built to pop without causing boiler outages. On accelerated tests in an Eastern Utility, one of these valves has been popped every day for more than 6 years. It has had only routine maintenance, and yet it pops consistently at set pressure, and does not leak. In the Chief Engineer's own words—this is the equivalent of at least 40 years' normal service.

2 Accurate Popping—Once set at the desired popping point, the Foster 38-SV pops on the button for each successive pop. For instance, in another Utility installation, the 38-SV under test was set for 600 lb. and popped 50 times in quick succession. The first pop was at 600 lb. and the 50th pop was at 595 lb. In spite of the heat of this abnormal operation, the Foster 38-SV was thrown off less than 1%. After a short cooling period, it again popped at 600 lb. That's test gauge accuracy!

3 Minimum Blow-down—Foster 38-SV's are adjustable so they can be set to reseat when pressure has dropped as little as 1% below the popping point. In this same test the 38-SV, on its first pop, reseated at 594 lb. for a 6 lb. or 1% blow-down. On the 50th pop, it reseated at 589 lb. which is also 6 lb. or 1%. After each pop, it reseated positively with no chattering or leakage. Only over-pressure up the stack—no useful steam wasted.

4 High Relief Capacity—Foster 38-SV's have larger bore because they can handle larger volume of steam and still control blow-down. Depending on operating conditions, they may give more than twice the capacity of other makes, as in the case of 5 Foster 38-SV's required to replace 12 "conventional" safety valves of the same nominal size. Fewer valves to buy—fewer valves to service.

5 Low Maintenance—Hot or cold, the piston in the 38-SV fits loosely and cannot stick, and yet no steam reaches the spring. The spring stays cool enough to touch, even while the valve is popping—which means longer spring life. Disc and seat expand at the same rate during heating-cooling cycles—there is no drag to destroy seating surfaces. Simmering and chattering have been eliminated as a source of destruction. Discs will not warp or crack. When routine inspection and maintenance are indicated, complete loading assembly lifts out without disturbing the spring setting.

For full details on the design and construction features that enable this valve to outperform any other safety valve, get in touch with your Foster Representative or with us direct.

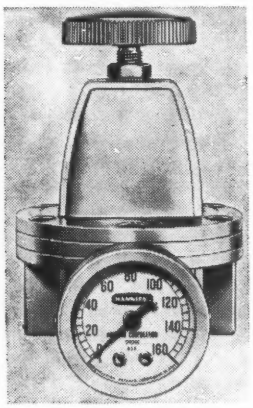
FOSTER ENGINEERING Company

PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

111 MONROE STREET • NEWARK, N. J.

plates are built of abrasive resistant steel and are furnished in either flat or stepped pole face. Two models are available. One is for stationary installation in open chutes, while the other, equipped with hinges and latches is recommended for closed chutes. Both models are fully insulated to prevent magnetic leakage which allows direct installation on steel. The Giant magnet protects crushing and grinding machinery and in many instances, prevents explosions caused by coal dust, are available in sizes ranging from 6 in. up and can be built any size in order to give magnetic protection the full width of conveying lines. Special designs are available. Eriez Manufacturing Co.

Y Air Pressure Regulating Valve. A new automatic pressure regulating valve designed specifically for service on com-



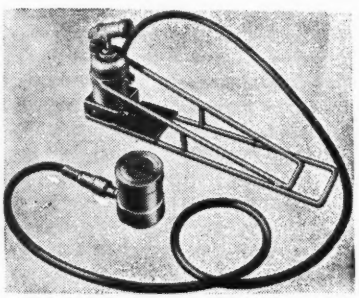
pressed air supply lines is announced. The regulator is for use on initial, or primary, air pressures up to 150 psi and can be set to maintain reduced, or secondary, pressures ranging from 125 down to 5 psi. Through the use of a free-floating valve stem, it is possible to back-off, or reduce the delivered pressure under dead end conditions merely by turning the adjusting screw. Hannifin Corp.

Z Solderless Pigtail Connector. Known as the Sta-Kon Wire Joint, this new connector complies with all requirements of the National Electrical Code. Maximum wire capacity of the joint is 3 No. 12 solid or stranded wires A.W.G. Over one hundred other approved smaller wire combinations can be used in this same connector. The body is made of bronze, electrotin plated. To insure that wires are fully inserted both ends of the body are open for quick visual inspection. Excess wire is easily snipped. The vibration-proof insulating cap is made of thermosetting phenolic material. As the cap is tightened, the body squeezes into the built-in recess at the bottom of the cap to hold the joint securely in place by a wedging action in the thermosetting material. Thomas & Betts Co.

AA Self-Sharpening Floor Scraper. A newly designed scraper is constructed of corrosion-resistant non-sparking aluminum bronze with serrated edges so constructed that the scraping edge is flat against floor or scraping surface. Serrations assure a better cutting edge and impart a self sharpening action to the tool. Produced primarily as a safety tool for use in cleaning floors and walls of paint spray booths, and other hazardous locations, this new tool may be used wherever hard-to-remove surface substances accumulate.

The new scraper is 8 in. wide with a deflected back. It weighs 1¼ lb. A 54 in. handle is recommended but not included with the scraper. Ampco Metal, Inc.

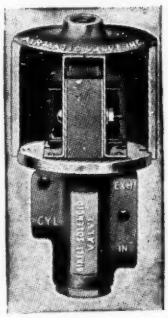
BB Tight Spot Jack. A hydraulic jack with independent pump unit is now avaliable for getting into those tight spots where jacking



must be done. This jack with a reputed capacity of 30 tons is only 4½ in. high when closed, 6½ in. when raised. The jack and pump weigh a total of 38 lb. Jack is furnished with heat treated, pointed and radius detachable tops. Catalog number is 30-H-45. Duff-Norton Mfg. Co.

CC Safety Goggles. Safe-T-Vis, a new type of safety goggle is the result of many years of research to find a material that would incorporate the lightness, comfort and added safety features of plastic but which would resist surface scratchings. They are made of an allyl casting resin, a new kind of plastic for this use, meeting all these requirements and providing many times the surface hardness of any other plastic used for eye protection. The lenses are available in four goggle styles and in a selection of sizes. The Univis Lens Co.

DD 3-Way Solenoid Valve. This non-corrosive, full capacity, 3-way direct operating, high speed, solenoid valve, Model DS-3, is said to eliminate pilots, levers, distributors, and other types of indirect control. They con be mounted in any position and operated continuously. The solenoid is rated 1.42 amp



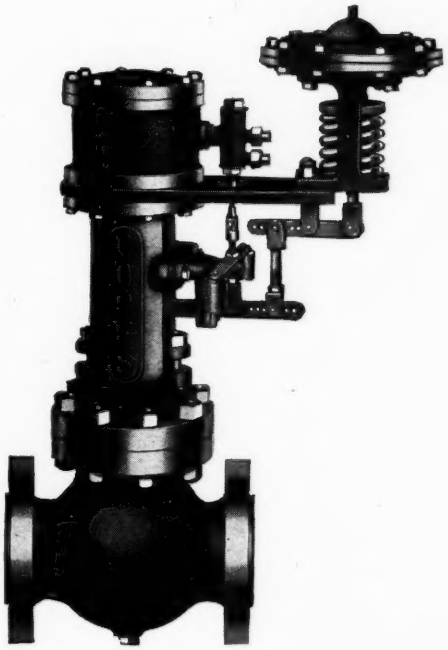
inrush, .22 amp holding, at 110 v, 60 cycles. Internal parts are precision machined and corrosion resistant. Furnished in 4 sizes, ¼, ⅜, ½ and ¾ in. Airmatic Valve, Inc.

EE Portable Handy Stand. A helper for repairmen has a flexible shaft machine mounted on a compact easily transported cabinet containing 25 accessory tools, and supplies that enable the repairman to work on a job where he finds it. Power is supplied by a ⅓ hp motor, 110 or 220 v, 60 cycle, a c. The flexible shaft is 5 ft long with internally controlled flexing built into the shaft housing. Three speeds are provided, 1400, 2400, or 4500 rpm with

V-belt drive. The cabinet is 32 in. high, on 3 caster legs, constructed of steel, has gray crackle finish, and glossy black trim. Equipped with shelves, it enables the repairman to find the desired tool instantly. Tools and accessories are suitable for: sanding wood or metal, drilling, wire brushing, grinding, buffing, sawing, and for filing. Shipping weight is 100 lb. Wyzenbeek & Staff, Inc.

For more exacting

PRESSURE REDUCING JOBS



Type R-DSLH, relay-operated for remote control
Below: Type DBI is direct-operated and self-contained

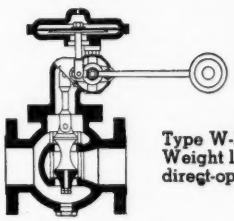
COPES Pressure Reducing Valves are designed for tough jobs demanding greater accuracy and dependability than can be obtained with ordinary stock valves. They are built to give as good results under emergency conditions as in normal service—to avoid objectionable vibration, noise and wear. Each is engineered for the individual installation, to assure close pressure control and long service life with minimum maintenance.

The COPES line is complete, covering a controlled pressure range from 27 inches of mercury vacuum to 600 psig. Valves are direct- or relay-operated, self-contained or actuated by a master control—as dictated by the individual operating conditions. Write for Bulletin 477.

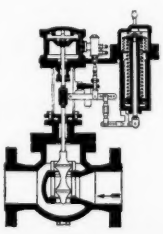
ENGINEERED BY THE MAKERS OF COPES

FLOWMATIC

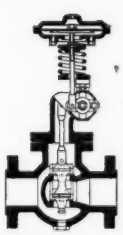
NORTHERN EQUIPMENT COMPANY
582 GROVE DRIVE, ERIE, PA.
BRANCH PLANTS: Canada, England, France and Austria
Representatives Everywhere



Type W-DBI. Weight loaded, direct-operated



Type 3-SH-2C for heavy duty. Relay-operated, self-contained



Type R-DBI for remote control from master

COPES

Headquarters for . . .

Boiler Feed Water Control . . . Excess or Constant Pressure Control, Steam or Water . . . Liquid Level Control . . . Balanced Valves . . . Desuperheaters . . . Boiler Steam Temperature Control . . . Hi-Low Water Alarms.

Oil Company

"Without doubt, YARWAY Steam Traps are finest traps ever built. All trap replacements will be YARWAY hereafter."—Oil Company, Texas.

Cleaning Plant

"As soon as we installed the YARWAY trap our trouble ended. Since then, when other traps gave trouble, we put in YARWAYS and they always did a much better job. Now we use all YARWAY traps," says Maintenance Engineer of large mid-western cleaning firm.

Dairy Company

"YARWAY Traps have been a life saver here. Used many different makes before trying YARWAY a year ago. Haven't touched them since. Trying to get management to buy more."—Large Wisconsin dairy.

Dye Works

"Use a good many YARWAY Traps here—like them very much on dryers. Take up little room and discharge condensate as fast as it comes through the line, causing coils to heat up faster and hold steady temperature."—Globe Dye Works, Philadelphia, Pa.

SPEAKING OF STEAM TRAPS

Laundry

"Ironer is so hot it sizzles after putting YARWAY trap on in place of a bucket trap. Run heavy spreads through ironer once and they are dry. Pulling out all bucket traps and will replace with YARWAYS."—Farina Laundry Co., Vancouver, British Columbia.

Power Station

"A great many YARWAY Traps are used here and have been very successful . . . some of these traps have been in use since 1939 and have given absolutely no trouble."—Herkimer Municipal Power Station, Herkimer, N. Y.

Florist

"Coal bill last winter was $5,000 less than previous winter. Didn't know whether they could give YARWAY Traps all the credit, but they were entitled to a big share of it."—Meyer and Santman (Greenhouses), Wynnemoor, Pa.

Hospital

"Ten years ago replaced an.....trap with a tiny ½" #60 YARWAY on an ironer. Never had such good results before. Trap has never been opened and still going 100%. Since then have bought nothing but YARWAY Traps and will specify them for new addition."—Northern Wisconsin hospital.

Textile Plant

"One large press formerly equipped with a bucket trap wouldn't heat lower platen. A ¾" YARWAY Trap was installed and since then full production has been maintained. This represents an increase of 20% in production."—Southern textile mill.

ACTUAL SIZE
½" TRAP

NEARLY 600,000 BOUGHT!

ORDER YARWAY TRAPS FROM YOUR NEAREST MILL SUPPLY DEALER. FOR NAME AND FREE TRAP BOOKLET, WRITE . . .

YARNALL-WARING COMPANY 114 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

Electric Power and Our National Defense Program

By WALKER L. CISLER

WHAT ELECTRIC POWER made possible in the last war is known in a casual way to millions of Americans. It was never too little or too late in the United States. No group more fully met its patriotic responsibility and duty than did our utilities. Many times those of us who were in war zones gave devout thanks for this, as we watched great unending streams of supplies and equipment rolling forward to the front. It gave to the nations with which we were allied a visual sense of strength and formidableness which was almost beyond comprehension because of its size and scope. It caused those nations and people to feel that their own future strength was basically tied in with and dependent upon a development of their own industrial capacity, and as a part of this, upon the development of their electric power resources.

So, it is understandable to see now, in the requirements presented by the 16 nations of Europe under the Marshall Plan, an ambitious and highly desirable program for the expansion of their electric power resources. Such a program calls for the addition of about 24,000,000 kw of new generating capacity during the next 5 years. It cannot be achieved within that time, for it would probably require years more to complete because of a number of factors, such as capacity of and wartime damage to manufacturing plants, and lack of manpower, materials, fuel, and transportation. It is, nevertheless, important from our national defense standpoint that these nations be strong industrially, and to be so, they must have adequate electric power resources even though it will take longer to complete the program.

Let us consider for a moment the importance of electric power to our peacetime economy, because a healthy peacetime economy is essential to maintaining a strong national defense position. Our United States electric power industry is today engaged in the greatest expansion program of its history in order to make up for what could not be added during the war and to meet postwar load increases.

In planning our peacetime expansion program, we must not lose sight of what our needs may be in preparing for a future conflict using equipment and weapons of far-reaching significance. Serious and constructive steps have already been taken to bring about closer cooperation between our industry, both manufacturing and operating, and the government agencies concerned, for the common purpose of preparing our defenses. It is to be hoped that measures to bring about a fuller working relationship will be stimulated to a still greater degree. In this respect, the Department of National Defense is the logical government agency that should be concerned with the subject.

Specifically, there should be appointed by and made answerable to that Department an Electric Power Industry Advisory Group with the following responsibilities:

1. To keep currently informed on electric power load and capabilities throughout the country, preferably on an area basis.

2. To keep currently informed on anticipated loads and additions to capacity for 5 years ahead.

3. To keep informed as to possible new loads which are known only to the Armed Forces.

4. To consider matters of planning from a national security standpoint such types and sizes of generating stations, transmission and switching facilities, and amount of reserve capacity needed for reasonable reliability.

5. To keep informed on manufacturing capacity for main generating, transformation, and switching equipment.

6. To keep informed on the electric power situation outside of the United States in those countries which might be allied with or opposed to us in the event of future hostilities.

Membership on such an Industry Advisory Group should be from the top engineering executive levels of both government and industry, so that adoption of policies can be effectively carried out within their respective organizations and the industry in general.

In the United States, the postwar period has been characterized by an unprecedented growth in electric load, and reserve capability of electric systems in the aggregate has been reduced to a margin which is admittedly too narrow. Every utility organization is attempting to re-estab-

(Continued on page 111)

Walker Lee Cisler has been executive vice president of The Detroit Edison Co., since December, 1947. He was born in Marietta, Ohio in 1897; was graduated from Cornell University in 1922 with a degree in mechanical engineering.

He was employed in 1922 by Public Service Electric and Gas Co., New Jersey, as a cadet engineer and gradually advanced to general superintendent of generation, and assistant general manager of the electric department. Prior to the outbreak of World War II, he was loaned to the War Production Board, Office of War Utilities, to assist the Government in mobilizing electric power for the war.

In 1943, Mr. Cisler was employed by The Detroit Edison Co. and granted a leave of absence to serve in the U.S. Army, at the request of the War Department. He was commissioned a Lieutenant Colonel and immediately sent overseas, first to the Mediterranean Theatre of Operations, then to the European Theatre of Operation, where he became Chief of Public Utilities Section, Supreme Headquarters Allied Expeditionary Forces (SHAEF). In January 1945, he was promoted to Colonel and after the dissolution of SHAEF was appointed Chief of the Public Utilities Section, OMG for Germany.

In November, 1945, he returned from overseas and assumed the duties of the Chief Engineer of Power Plants of The Detroit Edison Co. and was given his present post in 1947. In addition he acts as a Consultant to the War and State Departments on electric power in occupied and other areas, and also to the Mexican Government on electric power. He also serves as a consultant to the AEG.

Since the beginning of his career, he has served actively on various technical and administrative committees of the EEI, ASME, AIEE, of which he is a Fellow and past chairman of the Committee on Power Generation. Above excerpts from paper before 1948 Annual AIEE meeting.

Two Years' Operation at Jennison

Details of operating experiences and station performance for 1946 and 1947 at Jennison Station of New York State Electric & Gas Corp., on Susquehanna River at Bainbridge, N.Y. . . . Station burns anthracite, of 11,550 Btu per lb average heating value, on largest traveling-grate stokers in utility service . . . Initial installation of two 650-psi, 825-F steam generating units each of 200,000 lb per hr capacity, supplying steam to one 30,000-kw turbine generator . . . Station net heat rate 13,282 Btu per kwhr

By **W. GREACEN 3rd** Mechanical Engineer New York State Electric & Gas Corp.

JENNISON STATION, because of its many unusual features, enjoyed considerable publicity at the time it went into operation in December 1945. During the past two years the operating results of this station have been more than satisfactory and may be considered a tribute to the planning and foresight of the late W. G. Hickling, former vice president and general manager, who sponsored the use of anthracite for fuel in this station.

One of four major generating stations of New York State Electric & Gas Corp., Jennison Station is located at Bainbridge, N.Y. on the Susquehanna River. Due to limitations in circulating water, the ultimate plant capacity will be 60,000 kw based on the same heat cycle. The first unit consists of one General Electric Co. 30,000-kw turbine generator and two Combustion Engineering Co. 200,000-lb per hr steam generators operating at 650 psig, 825 F. Number 4 Buckwheat anthracite is burned on Combustion Engineering Co. Lloyd traveling grate stokers 24 ft wide by 28 ft long, the largest traveling grate stokers in utility service.

Boiler performance has been better than predicted for the grade of anthracite specified, in that the yearly average operating efficiency practically equalled the design efficiency for the first year and exceeded the design efficiency for the second year's operation. Availability of boiler and auxiliaries has been high. Reliability of turbine and auxiliaries has been practically 100 per cent.

In two years 532,000,000 kwhr have been generated, for which 292,500 tons of No. 4 anthracite have been burned. This fuel is enough to fully load a train of approximately 4,200 70-ton cars. The steam generation has totaled 5,277,200,000 lb. The equivalent steady load operation of the station for this period was at a turbine output of 31,630 kw, equivalent to 105 per cent of name-plate rating and average individual boiler output of 160,600 lb per hr, which is equivalent to 80.3 per cent of design maximum.

The boiler performance, remarkable for a fuel so low in heating value and high in ash content, can be attributed to the excellent stoker performance and the effective design of the cinder reburning system. At the average boiler rating, the design unburned carbon loss was predicted to be 4.1 per cent. Actually this has been as low as 2.6 per cent at the same output and has averaged about 3.1 per cent.

Where a dark, cinder-laden stack discharge was anticipated, a surprisingly light dust loading and light-gray color has materialized.

Erosion Problems

The problem of erosion due to burning of anthracite was recognized and every precaution was taken to mini-

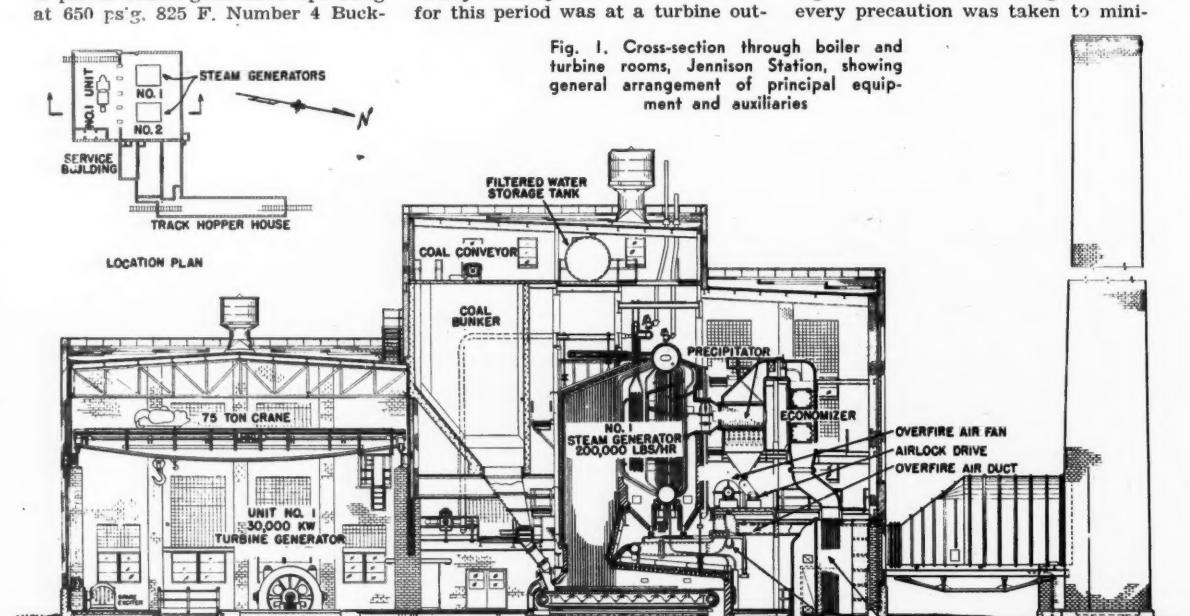


Fig. 1. Cross-section through boiler and turbine rooms, Jennison Station, showing general arrangement of principal equipment and auxiliaries

mize the condition. Western precipitators with high collection efficiency were installed ahead of the economizer, air heater and induced draft fans.

Periodic inspection of this equipment has shown that the wear is no greater than that produced by bituminous coal fly ash. Wear on the multiclone precipitator is remarkably little and the life of these parts greatly exceeds that anticipated.

We have experienced some boiler tube erosion. This has occurred in the superheater and certain areas of the main tube bank. Shields have been installed in the vulnerable areas, thus greatly minimizing the problem. Recirculation of cinder particles has, undoubtedly, accelerated the erosion. Cinders from boiler hoppers and precipitators are now re-introduced with air through nozzles at the rear of the stoker in an attempt to burn as much as possible in suspension. While a large portion is consumed, as is evidenced by a sharp drop in output when cinder recovery is cut off momentarily, there still is a certain amount of recirculation, which is undesirable.

During the first few months of operation, soot blowers were operated about on the same schedule as on bituminous fired units. Experiments conducted in discontinuing soot blower operation indicated that, with this particular

Table showing summary of performance of Jennison Station for 1946 and 1947

STATION	1946	1947	Total or Average
Service Hours	8604	8215	16819
Generation—Million Kwhr	262.2	269.8	532.0
Station Use—Million Kwhr	11.8	11.5	23.3
Net Generation—Million Kwhr	250.4	258.3	508.7
Fuel Fired—Net tons	144,383	148,106	292,489
Coal Rate, Gross—lb per Kwhr	1.101	1.098	1.100
Heat Rate, Gross—Btu per Kwhr	12,827	12,542	12,700
Heat Rate, Net—Btu per Kwhr	13,448	13,116	13,282
TURBINE GENERATOR			
Service Hours	8,604	8,215	16,819
Availability—per cent	99.7	99.6	99.6
Average Output—Kw	30,475	32,845	31,630
Average Exhaust Press—In. Hg abs	1.091	1.211	1.151
Average Steam Rate-lbs. per Kwhr	10.07	9.77	9.92
Average Heat Rate—Btu per Kwhr	10,521	10,527	10,524
STEAM GENERATOR (Two units combined)			
Service Hours	16,350	16,500	32,850
Availability—per cent	96.7	96.0	96.4
Steam Generated—million lb	2,641	2,636	5,277
Average Output (each unit)—lb per hr	161,550	159,750	160,600
Average Overall Efficiency—per cent	82.4	84.0	83.2
Design Overall Efficiency (same condition)—per cent	82.9	82.9	82.9
FUEL—As Received			
Average Heating Value—Btu per lb	11,661	11,442	11,550
Average Volatile Matter—per cent	5.93	6.11	6.02
Average Fixed Carbon—per cent	71.95	73.69	72.82
Average Ash—per cent	10.16	10.97	10.57
Average Moisture—per cent	10.53	11.34	10.94
Average Sizing: On 3/32" Round Mesh—per cent	10.85	11.90	11.41
Thru 3/32" on 3/64" Round Mesh—per cent	65.32	63.80	64.66
Thru 3/64" Round Mesh—per cent	23.81	24.30	24.09
Ash Fusion Temperature—deg F	2,900+	2,900+	2,900+

$$\text{Availability} = \frac{\text{Service Hours}}{\text{Service Hours} + \text{Forced Outage Hours}} \times 100$$

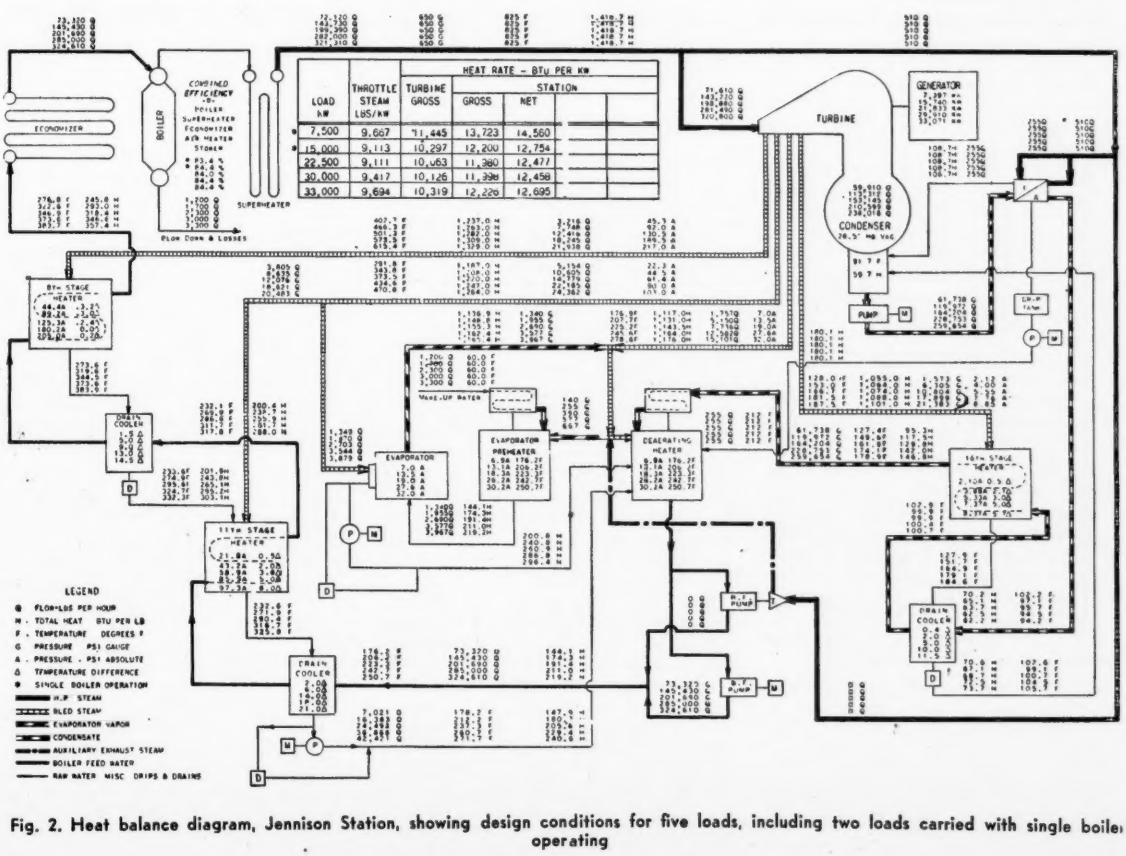


Fig. 2. Heat balance diagram, Jennison Station, showing design conditions for five loads, including two loads carried with single boiler operating

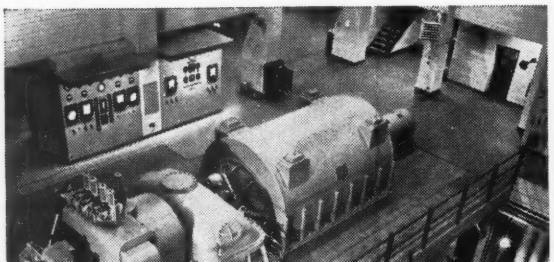


Fig. 3. View of 30,000-kw, 650-psi, 825-F turbine driving hydrogen-cooled 13,800-v, 3600-rpm generator, Jennison Station

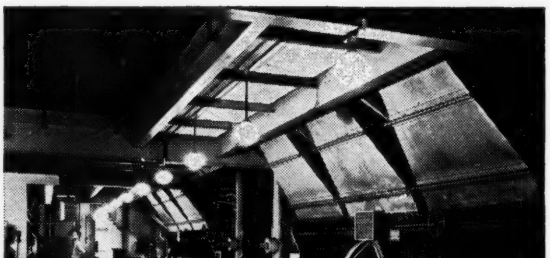


Fig. 4. Two Jennison steam generating units, 200,000 lb per hr each, fired with anthracite by traveling-grate stokers each 24 ft by 28 ft

grade of anthracite, soot blowers were not required. In fact, boiler performance improved, due to the steadier cinder collection rate from boiler hoppers and precipitators resulting in improved cinder burning. Experiments with higher volatile (8 per cent to 10 per cent) anthracite indicated that soot blowers would have to be used.

Superheaters

There was, originally, a slight deficiency in temperature of steam leaving the superheater. Although the effect on the plant heat rate was almost negligible, the control of the steam temperature by means of the superheater by-pass was lost, and the per cent moisture discharged to the main condenser was undesirably high.

Masking of a portion of the lower water-wall sections resulted in a sufficient rise in the temperatures of the gases entering the superheater to restore steam temperature control and make it possible to maintain optimum steam temperature at the main turbine throttle.

Induced Draft Fans

Because of the abrasive nature of anthracite fly-ash, special consideration was given to protecting the induced draft fans. Slow-speed, paddle-wheel fans were selected as being erosion resisting.

Variable-speed drives were utilized in order to keep fan tip speeds at the minimum required by boiler load. Periodic inspections have shown, however, that fan blade erosion is very slight, indicating that higher speeds and curved blades in the induced-draft fans may be practical.

The coal handling system consists of a 70-ton track hopper emptied by reciprocating feeders to a belt conveyor, thence to a centrifugal discharge elevator, and thence to a cross belt to a screw conveyor discharging into a completely-enclosed concrete coal bunker.

Coal Handling

Feeders, belt conveyors and screw conveyor have been quite satisfactory. Some concern regarding the maintenance on the screw conveyor has proved unfounded. The screw runs in a trough, lined with abrasion-resistant tile. Some difficulty was experienced with the stellite face of the screw, but this was a matter of poor application and readily corrected. Flights are replaced as wear becomes excessive; however, overall maintenance is low.

Considerable maintenance has been experienced on the bucket elevator due to the highly corrosive action of the moisture in the fuel, and to abrasion. Replacement of chain and buckets with alloys to resist this abrasion and corrosion are being tried out. Cast links and pins of manganese steel show signs of promise, though these have not been in service long enough to be certain of the results.

Oil-fired car thawing pits have been added. These are installed between rails of tracks and have proved very successful in defrosting frozen cars. Six pits accommodate two 50- or 70-ton cars.

The unusual bunker design, with convergence to the gates provided by sloping a portion of the bottom, at one side only, has resulted in very satisfactory performance. The bunker is constructed entirely of reinforced concrete and the sloping section is lined with quarry tile. No difficulties have been experienced with arching or hanging up of coal since the plant went into operation.

Ash discharge from the stoker drops through quench sprays into a cast-iron refractory-lined hopper, with a capacity sufficient for about 10 hr operation at full boiler output. Each shift the discharged ash is sluiced to the flooded transfer sump below, whence it is pumped to the fill area by 1,000-gpm, rubber-lined, ash-water pumps. The stoker hopper is provided with a grid for manual crushing of clinkers. Operation has proved satisfactory. There has been little clinkering, and crushing has been relatively easy. The pit refuse has been very uniform and small in size. Due to the low combustible, the ash has had a ready market in cinder block manufacture.

Air Preheaters

As previously stated it was found unnecessary to operate soot blowers in the boiler. However, as a direct result of the effective removal of large cinder particles in the dust collector, there has been little scouring done by the discharged gases. Because the fly ash from the dust collector is very fine, fluffy deposits form on the air heater tubes. These are effectively and economically controlled by dusting with air jet hand lances.

Plant Loading

Turbine, condenser and auxiliaries have performed entirely satisfactorily. An unusual condition, worthy of comment, has been the high load factor required and obtained on this unit. The limitation on output is in the turbine throttle flow; and, because of the extreme pinch for capacity and because of the reserve output in the generator and boilers, this turbine is run much of the time with the 8th stage heater by-passed. This operation increases the heat rate by about 2 per cent, but increases capacity by 2,000 kw.

For complete detailed description of equipment in Jennison Station and basis of station design, see:

Jennison Station Adds 30,000 kw to Central New York Supply Facilities; *Electric Light & Power*, January 1946.

Simple Design, Reliability Keynote Jennison Station; by W. W. Perry and Walter Greacen 3rd; *Electrical World*, December 8, 22, 1945.

Jennison Steam-Electric Station is Outstanding; *Link-Belt News*, January, 1947.

Electrical and Mechanical Features of Jennison Steam Generating Station and Transmission Line Connections; by W. W. Perry and W. Greacen 3rd; paper before N. E. District AIEE, Buffalo, N. Y., April 1946.

Features of Jennison Station; by H. C. Schweikart, Gilbert Associates, Inc.; *Combustion*, December 1945.

Consulting engineers for this station, working with the engineers of New York State Electric & Gas Corp., were Gilbert Associates, Inc.

The Venturi-Scrubber . . . A New Device for Cleaning Stack Gases

THE VENTURI-SCRUBBER described below has recently been installed and operated in three full-scale installations, following extensive pilot plant tests. This scrubber, employing the well-known principle of the Venturi tube, was conceived by A. W. Anthony, Jr., president of Pease, Anthony Equipment Co., and others. They believed the effectiveness of the standard Pease, Anthony wet cyclone scrubber could be increased by adding finely atomized spray to the dirty gas close to the gas inlet, producing the effect by passing the gas at high velocity through a Venturi throat into which liquid was suitably injected. It soon became evident that something new had been discovered that was highly effective in removing fine solids from gases and the scrubber described here was finally developed.

Following extensive pilot plant tests in the summer of 1946 on salt cake fume from the kraft chemical recovery furnace of Thilmany Pulp and Paper Co., Kaukauna, Wis., a full scale installation of the scrubber, designed for efficiency of 90 per cent chemical removal from the flue gas, was made as shown in Figs. 1, 2 and 4 and has been in continuous operation ever since. Operating data show that the design efficiency of 90 per cent is being maintained.

A second full-scale installation, following pilot plant tests, was also made of this scrubber at the Corrigan-McKinney plant of Republic Steel Corp., Cleveland, Ohio, Figs. 3 and 6. Since November 28, 1947, this scrubber has been in operation removing iron oxide fume from the stack discharge of an open hearth furnace in which oxygen is being used. Collection efficiency in this installation, according to latest operating data, is approximately 98 to 99 per cent and the effectiveness of the scrubber in eliminating the serious fume nuisance is attested by the user and by the smoke elimination officials of the City of Cleveland. A duplicate unit was put into operation by Republic late in December.

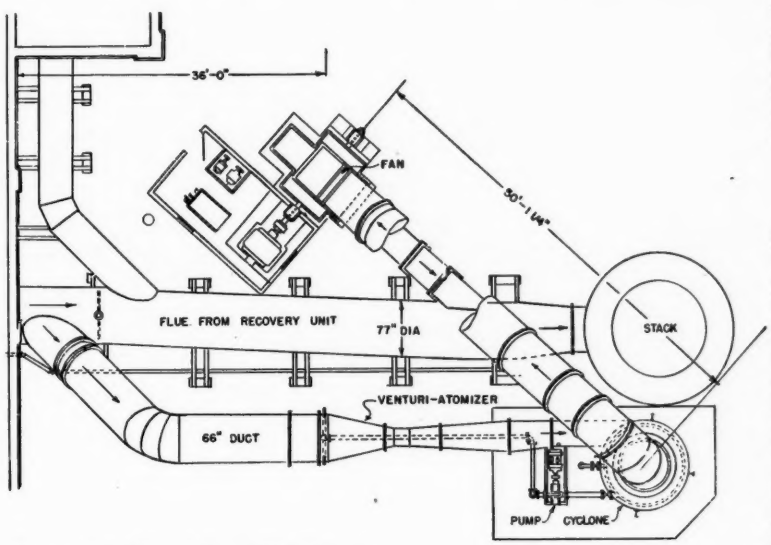
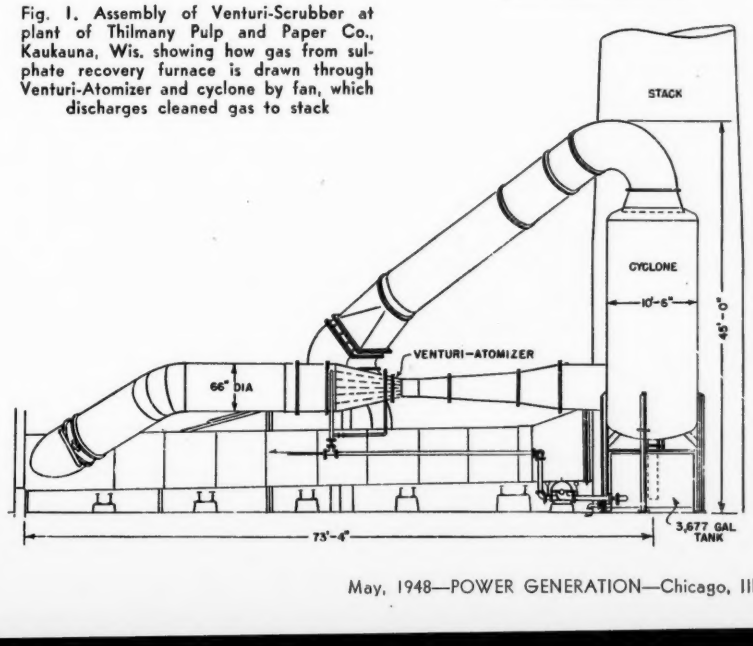


Fig. 1. Assembly of Venturi-Scrubber at plant of Thilmany Pulp and Paper Co., Kaukauna, Wis. showing how gas from sulphate recovery furnace is drawn through Venturi-Atomizer and cyclone by fan, which discharges cleaned gas to stack



Principle of Venturi-Scrubber

Details of the installation at Thilmany Pulp & Paper Co. are given below. The Venturi-Scrubber shown in the illustrations operates on the principle that the gases to be scrubbed are accelerated in a Venturi throat and the energy of the gases is used to atomize streams of water or liquor. This atomization of the liquid produces very small droplets and the throat appears to be filled with a wall of spray. The collision of the dust particles with this wall of spray, also the subsequent scrubbing of the gases due to the turbulence and mixing of gases and liquid in the atomizer, results in a high efficiency of dust removal. The atomized liquid is thrown out of the gas stream in a cyclone and the gases then pass through a powerful induced draft fan.

Data on Thilmany Venturi-Scrubber

Venturi Atomizer—The throat is 25 in. I. D. and 6 in. long. The scrubbing liquor is injected into the gas stream through 19 properly-spaced nozzles whose holes are in a plane 3 inches upstream from the leading edge of the throat. These nozzles are ¾-in.

[1]Pilot plant development of the Venturi-Scrubber on sulphate recovery furnace stack gases was completely described by T. T. Collins, Jr., C. R. Seaborne, and A. W. Anthony, Jr. in *Paper Trade Journal*, June 5, 1947 and further details were given by T. T. Collins, Jr. in *Paper Industry & Paper World*, August, September, October, 1947. Report on full-scale Thilmany unit by three above authors, *Paper Trade Journal*, January 15, 1948.

[2]Photographs from Thilmany Pulp and Paper Co. used by permission of Technical Association of Pulp and Paper Industry, which published a paper on this subject, including these illustrations, on January 15, 1948.

Table showing results of tests of Venturi-Scrubber pilot plants on several industrial dusts, fumes and smokes

Type of problem	Efficiencies %			Gas Conditions			
	P-A Scrubber Alone	Venturi Alone	Venturi Plus Scrubber	Loading grains per cu ft	Temp. deg. F	Vol. CFM	Draft Loss Venturi plus cyclone "w.g.
Salt cake fume kraft pulp mill 0.1 to 1.5 micron	60-70	85-94	95-99	1.5-2.5	300	2800	12-15
Steel open hearth gas with oxygen into steel bath 0.015 to 15 microns	80	90	95.5-99.7	1.0-6.0	600	10,000	14-16
Arc furnace fume and smoke 0.01 to 0.35 microns	40-55	60-74	83-86	0.25-3.5	200-300	1500	12-15
Smoke and odor from vaporized fatty material — unknown sizes but bluish-whitish in color, hence below 0.5 micron probably		80-90	?	?	——	2000	12-15

stainless steel pipes flattened on he end, with six ¼-in. diameter holes radially spaced around the pipe about 3 in. from the flattened tip. These nozzles are fed liquor at 5 to 10 lb pressure from an upstream manifold in the large duct ahead of the converging section of the venturi.

The velocity of the gas at 300 F through the throat of the atomizer is 230 to 260 ft per sec with the gas volume 45,000 to 50,000 cfm.

Liquor System: — The scrubbing liquor is a recirculated solution of fume from the stack gases, maintained at 29 to 32 deg Baumé by a continual bleed-off of liquor to the disc evaporators. This solution is about 30 to 32 per cent salt cake on a sodium basis, and contains sodium sulfate, thiosulfate, sulfite and bicarbonate; some dissolved hydrogen sulfide; and carbon. The temperature of the scrubbing liquor remains at 155 to 160 F and its pH is approximately 8 to 9 (alkaline) most of the time. The level of scrubbing liquor in the sump tank is maintained constant with fresh water from a float-controlled valve.

The scrubbing liquor is pumped through basket filters (⅛-in. perforations) to the spray manifold ahead of the venturi throat. About 6 gal of liquor per 1000 cu ft of gas area are injected. It is atomized and thrown out of the gas in the cyclone from which it drains into the sump tank to be recirculated to the atomizer. The liquor bleed-off amounts to 4 to 5 gpm and the fresh water make-up is somewhat more, depending on the hot gas temperature and water vapor content.

Fan: — Most of the work in the Venturi-Scrubber is done by the fan which pulls the gases through the Venturi atomizer at high velocity. The Thilmany fan, not of modern design, is said to be 55 to 60 per cent efficient by several fan companies and handles the gas, now cooled to about 163 F and saturated, at about 18 to 22 in. of water pressure drop. The total power load of the Thilmany installation is approximately 250 kw continuously or about 40 kwhr per ton of pulp. It is believed that changes in design of the Venturi atomizer and installation of a modern fan will reduce this power requirement for similar installations operating on fume solution. The motor driving the fan is a 350-hp synchronous motor.

Operation — The Venturi-Scrubber is simple to operate. By hand valve regulation, sufficient liquor is injected into the Venturi throat to leave a slight vacuum ahead of the atomizer for stack effect on the furnace. The liquor bleed-off is regulated by a valve to maintain the desired concentration of scrubbing liquor. The Venturi throat is lanced with a high-pressure water stream once a day (or when necessary) to keep the pressure

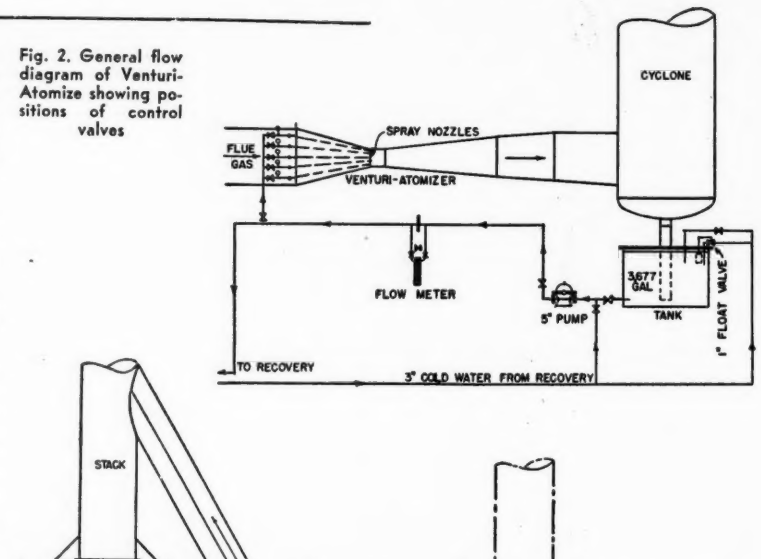


Fig. 2. General flow diagram of Venturi-Atomize showing positions of control valves

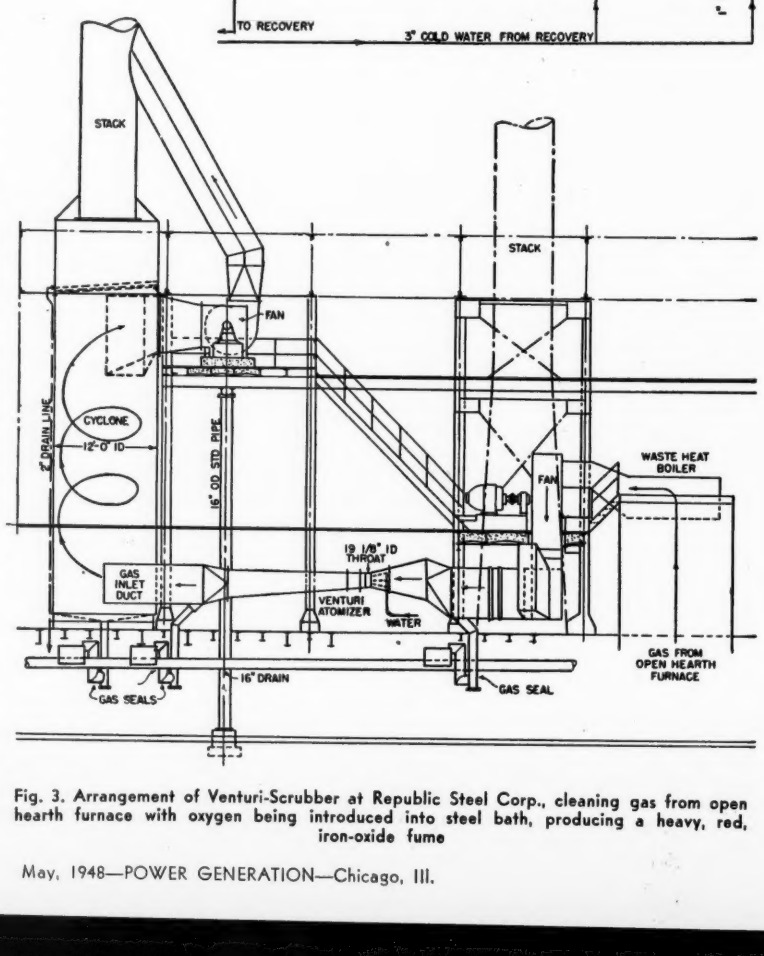


Fig. 3. Arrangement of Venturi-Scrubber at Republic Steel Corp., cleaning gas from open hearth furnace with oxygen being introduced into steel bath, producing a heavy, red, iron-oxide fume

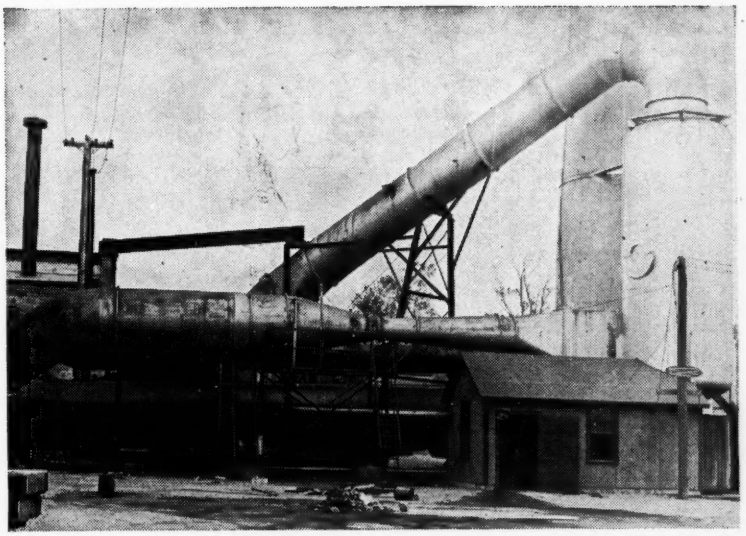


Fig. 4. General view of Venturi-Scrubber at Thilmany, showing actual installation of the equipment diagrammed in Figs. 1 and 2

drop across the throat (from causes other than atomizing liquor) at a minimum.

Efficiency — The Thilmany scrubber now operates at slightly above 90 per cent sodium removal efficiency. The dust removal efficiency is slightly higher. The unit was designed for only 90 per cent efficiency.

Operation of the Thilmany Venturi-Scrubber has continued to be satisfactory and is for the most part uneventful. Some corrosion of the black steel piping in the throat has developed and this piping was replaced with stainless steel, which had been previously tested and found satisfactory. Full control of the Venturi operation is through two valves and a manometer, as shown on Fig. 5. The solution recirculated to the throat is controlled by one valve to maintain approximately a constant, slightly negative pressure in the duct upstream from the venturi and this setting is frequently maintained for long periods of time. Since the fan is constant speed, increase in solution rate acts to reduce the gas flow and vice versa. The other valve varies the rate of bleed-off of strong solution back to the mill circuit.

Republic Steel Corp. Venturi-Scrubber

The first full-scale Venturi-Scrubber installed at Republic Steel Corp. was placed in operation in November 1947 and the following data were taken on that installation early in December, 1947:

Test No.	1	2
Dust loading, dirty gas, gr/cu ft (NTP)	2.08	3.71
Dust loading, clean gas, gr/cu ft (NTP)	0.032	0.009
Removal efficiency, %	98.5	99.76
Gas flow from fan, at 60 F (std) cfm	—	41,000
Gas flow from fan, at 130 F cfm	—	46,500
Gas flow into venturi at 780 F cfm	—	76,900
Pressure drop across venturi inches H_2O		14.0

Design of the units was based on 50,000 cfm at 600 F, using 175 gpm of water, with expected pressure drop of about 15 in. H_2O from pilot data

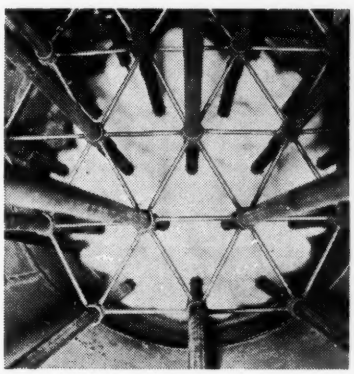


Fig. 5. View inside Thilmany Venturi-Atomizer looking downstream towards throat of nozzle, showing wall of spray. To obtain this picture, water was used as liquid and only air was passed through Venturi

When first started, pressure drop was 11 to 12 in. H_2O, with a lower gas flow, which was not accurately known. Test results are better than expected, which is also true of the appearance of stack discharge. This particular Venturi-Scrubber seems to be rather insensitive to changes in water rate, plugging of jets, etc. However, it is not yet known whether this is a general characteristic or pertains only to the iron oxide fume.

Corrosion of the unprotected steel was expected, because of the sulphur in the fuels, and its effects were at first somewhat worse than expected. Means of minimizing the corrosive effects are being considered. Broadly, there are two methods: first, recirculation of water maintained slightly alkaline, with settling and recovery of the iron oxide, using unprotected steel througout; second, complete protection of the steel by rubber linings and other coatings. At present writ-

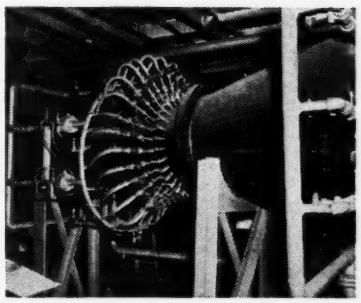


Fig. 6. View of exterior of Venturi throat on open-hearth furnace gas scrubber showing water feed arrangements (Republic Steel Corp. photo)

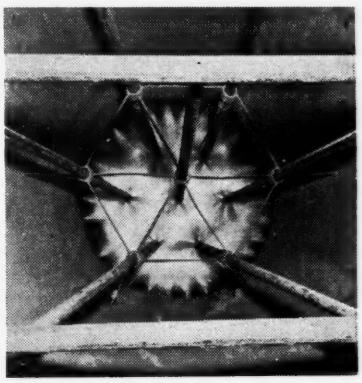


Fig. 7. View inside Venturi throat on open-hearth furnace gas scrubber, looking downstream and showing 7 central spray jets, also jets entering around periphery of throat (Republic Steel Corp. photo)

ing, enough soda ash or lime is fed into the river water, put through once, to keep the effluent water alkaline. Several paints are on trial.

Two major equipment companies have options on parts of Pease, Anthony scrubbing patent positions: The Babcock & Wilcox Co. on the new Venturi method in the field of recovering chemicals from stack gases in the manufacture of pulp; Chemical Construction Corp. of New York on both the new Venturi method and the older wet cyclonic method in all patent territory not already committed, excepting only the field of scrubbing boiler flue gases from power boilers to remove fly ash.

Chemico has started an extensive program of engineering investigation and development with particular reference to chemical and metallurgical scrubbing problems. Chemico has built a portable pilot unit small enough to go into an automoblie van for shipment to various plants for demonstration runs. This portable unit contains a conventional Pease, Anthony Scrubber of 1500 cfm capacity together with a Venturi of 1,000 cfm, complete with blower, pump, motors, controls and instrumentation; it is already in service and is being scheduled for a series of demonstrations in the East and Middle West.

How to Use Color Control Tests for Boiler Water

By F. R. McCRUMB
Chief Chemist
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Boiler water and feedwater treatment should be closely controlled from daily water tests by power plant operators . . . These can be made by simple color comparators, in which treated sample color is matched against standard colors and values read direct in ppm . . . This article tells you how to use color tests for phosphates, silica, pH, nitrates, steam condensate, polyphosphates . . . Why various water conditioning methods require these tests . . . Fundamental chemistry and calculations all done for operator in preparation of testing chemicals and color standards, marking of test tubes and pipettes for measurement, devices for comparing test colors with standard colors

BOILER WATER TREATMENT should result in maintenance of clean evaporating surfaces in the boiler, protection against general corrosion, pitting and intercrystalline cracking or embrittlement. Condition of the water should be such that the boiler will deliver an adequate supply of pure dry steam. Rate of blowdown must be held at an economical figure.

Boiler feedwater should be low in total solids, particularly scale formers, such as calcium, magnesium and silicate. It should be alkaline but not in too great an excess. Both oxygen and carbon dioxide should be removed as far as possible. Water in the boiler should be relatively free from hardness in all cases and, in high-pressure boilers hardness should be entirely absent. The water should be alkaline, with a minimum pH of about 10.5. The upper limit for pH will depend on the method of treatment.

Conditioning of boiler water is accomplished by external or internal treatment or a combination of methods employing various chemicals and equipment. Regardless of the excellence of the materials employed, chemical treatment is valueless unless it is closely controlled by means of daily chemical tests of the boiler water by the plant operators. This article shows how these tests can be quickly and accurately made by use of color compartors.

Proper control of the concentrations of soluble constituents in boiler water

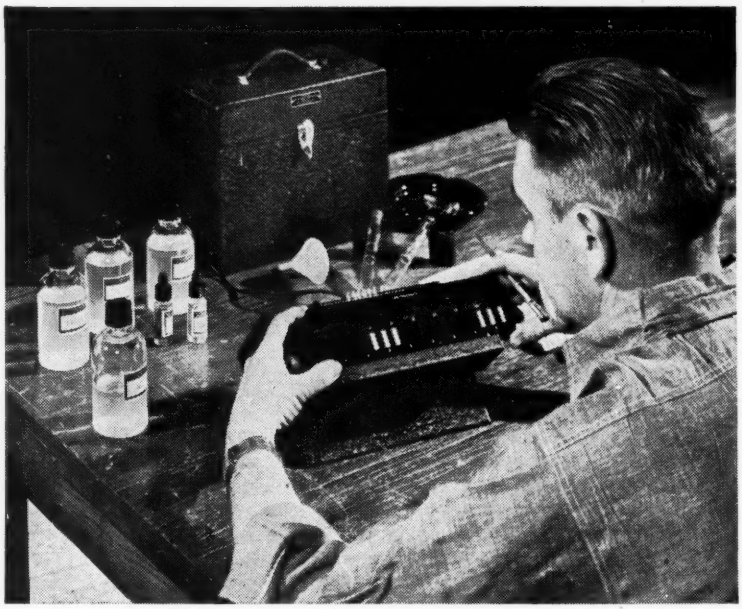


Fig. 1. View of power plant operator using a phosphate comparator to test boiler water, showing the chemicals and accessories included in the comparator. The phosphate comparator consists of:

Molded plastic comparator base.
Molded plastic slide containing nine color standard tubes, representing 5, 10, 20, 30, 40, 50, 60, 80 and 100 ppm phosphate as PO_4, alternating with tubes of plain water.
Five 5-ml test tubes.
1 vial concentrated stannous chloride with 0.5 ml pipette.
1 empty vial for dilute stannous chloride.
16 oz. molybdate reagent.
2 mixing tubes graduated at 5, 15 and 17.5 ml.
1 funnel and filter paper.

How to Test Boiler Water for Phosphate With the Color Comparator

Step 1—Wash the empty vial with distilled water and empty it. Fill the 0.5 ml marked pipette with concentrated stannous chloride solution to the mark and then put this solution into the vial. (1 ml means 1 milliliter = 0.001 liter; Liter is a fraction over 1000 cc). Fill the vial to the shoulder with distilled water and mix it well with the stannous chloride solution. Important Note: This diluted stannous chloride solution is to be used in making the tests. But it deteriorates in time and it is safest to make up a solution every day.

Step 2—Carefully filter the sample of water to be tested, to free it from suspended solids. Use a fine filter paper such as Whatman No. 5. If solid calcium phosphate is in the water, it will be dissolved by the acidic reagents in the test and the phosphate value obtained will be incorrectly high.

Step 3—Wash one of the mixing tubes with some of the clear filtered water to be tested. Then fill this mixing tube to the 5 ml mark—the lowest mark—with the filtered sample water, so that the bottom of the meniscus is even with the mark.

Step 4—Carefully add molybdate reagent to the water in the mixing tube until the liquid (bottom of meniscus) is level with the second mark or 15 ml. Insert a rubber stopper in the top of the tube and mix its contents well by shaking gently and inverting.

Step 5—Carefully add dilute stannous chloride, as prepared in Step 1, to the mixture of sample water and molybdate in the mixing tube, until the liquid (bottom of meniscus) is level with the top mark, 17.5 ml, on the tube. Mix the contents well. If the sample contains phosphate, it will turn blue; maximum color formation occurs in about 1 minute. Slow fading occurs after 10 minutes, so the color should be compared with the standards within 5 minutes.

Phosphate Test — Continued

Everything up to this point has been done to prepare the sample for testing by the color comparison method. This method is very simple. Here's all you have to do now.

Step 6—Put three of the 5 ml test tubes in the holes behind the slots in the base of the comparator. Fill the middle tube with the blue solution resulting from Step 5. Fill the other two tubes with a diluted sample made as follows: In your second mixing tube, put 5 ml of clear filtered sample water, and enough distilled water or tap water to make 17.5 ml and mix well. This diluted sample compensates for any original color present in the sample due to the presence of tannins and the like, if these have been used in the treatment.

Step 7—Put the slide containing the phosphate standards in position on the base and hold the instrument toward a window as in Fig. 2, or place it on a special Dalite lamp. Get arrows on slide and base directly in line, to position slide properly.

Step 8—Move the color standard slide on the base until color of the treated sample, center test tube, matches one of the standards or falls between two consecutive standards. Read the phosphate value, in parts per million, directly from the values on the slide. If the sample tube falls between two standards, take average of the two.

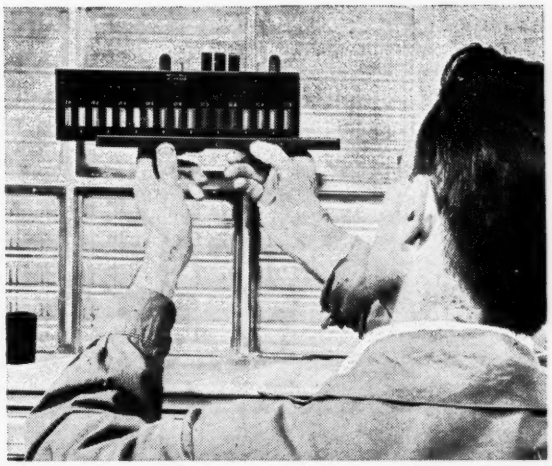


Fig. 2. View of operator reading phosphate value from phosphate comparator. He is holding it toward window, but may also place it on a special Dalite lamp, as shown in Fig. 1, useful when a clear daylight background is not available

results in separation of calcium and magnesium as a non-adherent sludge instead of an adherent scale. In low-pressure boilers, sodium carbonate may be used as the treating chemical. At higher pressures carbonate is decomposed to give caustic soda, a contributing cause of embrittlement, and in such cases carbonate is replaced by phosphates.

When sufficient phosphate is present in the boiler water, calcium unites with the phosphate to form a sludge and does not form calcium sulfate or silicate. General practice is to maintain a dependable excess of phosphate over the amount required to combine with the calcium entering the boiler. An excess of 30 to 50 ppm of phosphate ion (PO_4) is usually maintained and this may be determined with a phosphate comparator, as shown in Fig. 1.

The operation of the comparator is based on the formation of phosphomolybdic acid, which is then reduced with stannous chloride to give a blue color, the intensity of which depends on the amount of phosphate in the water. Other substances such as silica, iron, etc., will not cause errors with this method.

To test for phosphate with the color comparator, first prepare the testing reagent as in Step 1; then prepare the sample to be tested, Steps 2 and 3; next add predetermined quantities of a prepared chemical as directed, to turn the sample a shade of blue depending on its phosphate content, Steps 4 and 5. Finally, com-

(Continued on page 114)

How to Test for Silica with the Water Analyzer

Use portion of filtered sample prepared as directed for phosphate test.

Step 1—Measure 50 ml of the filtered sample water in a graduated cylinder and add to it 5 ml of the acid ammonium molybdate solution provided with the analyzer. Mix well. Allow the mixture to stand about 15 min but not over 20 min. The mixture will turn yellow if silica is present.

Step 2—Put the three sample tubes in the Analyzer. Place the Analyzer base in such a position that tops of sample tubes point toward a window or other source of daylight. Fill two of the tubes with distilled water and put them in the outside compartments. Fill the third tube exactly to the mark with the yellow solution prepared in Step 1.

Step 3—Place the silica slide in the slot so that one of the arrows on the slide is directly below the white mark on the base. Now compare the color of the treated sample with the silica standards by looking at the reflections of tubes in mirror and NOT by looking down through tubes. If the sample color does not match either of the standards or lies between them, move the slide until the next arrow is below the mark at the base. Continue this procedure until you obtain a match. Read value from slide; if it falls between two standards, take average.

Important Note: Phosphate will also react with the silica reagent to give a yellow color, which will indicate a higher silica content than is actually present. However, this color due to phosphates can be destroyed by oxalic acid.

Therefore, if you know phosphates are present in the water, carry out the silica determination as above but, when maximum color has developed, mix with the test sample 1 ml of a 10 per cent oxalic acid solution. Then make the reading on the analyzer as above.

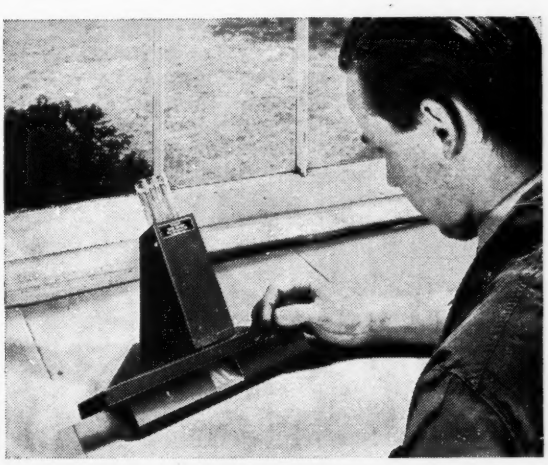


Fig. 3. View of operator testing for silica with the Water Analyzer
Water Analyzer consists of base, slide and three glass sample tubes. Wooden base, which serves as a holder for tubes, is set at angle of 45 deg and is divided into 3 compartments. An etched glass is placed across bottom of compartments to support tubes and also supply diffused light. Mirror is placed in bottom of base directly under three sample tubes. Slide is molded from plastic and moves in slot between etched glass and mirror. Each slide contains 9 color standards alternating with ampoules of water and is marked with values of standards.

Taking the Mystery Out Of the Amplidyne

Part 1. Basic principles of the Amplidyne — What it is and How it Works . . . How it is built . . . Amplidyne characteristics . . . Amplification and Speed of Response . . . Amplidyne Diagram Practice

By **W. H. WIGINGTON, Jr.** Control Engineering Division, General Electric Company, Schenectady, N. Y.

THE AMPLIDYNE has found wide acceptance in many industries. The steel, paper, machine tool, textile, aluminum, printing, and rubber industries are among those using the amplidyne to speed production and improve quality.

Despite its general adoption the amplidyne still seems vague and fearsome to too many engineers and electricians. The purpose of this article is to explain the operation of the amplidyne and to analyze its functioning in a typical circuit.

There is no need for the amplidyne to be shrouded in mystery. Without reading the nameplates on the machine one would hardly be able to differentiate it from any other small d-c generator. Except for distributed field windings, even the internal construction of the amplidyne is quite conventional.

What features make this machine so much more versatile than an ordinary exciter? The features which are essentially different are a short circuit, and a compensating winding. As far as the physical structure of the machine is concerned these are minor modifications. Yet these fundamental differences make exceptionally high amplification and very fast speed of response inherent characteristics of the amplidyne.

Essentially, this is what takes place in the amplidyne: A small current in a small field winding produces a small flux. This small flux induces a low voltage in the armature. This low voltage is short-circuited and a large short-circuit current flows. This large short-circuit current produces a large flux. It is this flux which is used to induce the normal voltage which is applied to whatever load is connected to the amplidyne. In order to gain a more complete understanding of just how the above steps are actually made to work it will be best to first review the operation of a conventional machine.

Conventional D-C Generator

Figure 1 shows the current and flux conditions existing in a conventional d-c generator. For simplicity the machine is shown with only the bare essentials of two poles and one field. This particular machine requires say 100 watts field excitation to produce the horizontal flux in which the armature rotates. This 100 watts field excitation produces sufficient flux to induce 100 v at the brushes of the armature. Assuming a 10 kw machine fully loaded, armature current will be 100 amp. Thus, 100 watts field excitation is required in delivering 10,000 watts output, or a gain of 100 to 1.

A flux is produced in the armature which is proportional, neglecting saturation to the armature current. This armature flux acts just as though the armature were a stationery coil in space. Furthermore, this armature flux is perpendicular to the field flux. For purposes of this explanation assume that the armature flux is about equal in magnitude to the field flux. In conventional machines this armature flux is known as armature reaction. Armature reaction flux interacts with the field flux in such a way that the field flux is distorted, or in effect rotated. The field flux shifts and in order to keep the brushes in the neutral electrical axis for best commutation it is necessary that the brushes also be shifted. This procedure would make it necessary to shift the brushes each time the armature load current changed. It is for this reason that the armature reaction flux is generally neutralized by the use of a commutating interpole or compensating pole face winding. In the amplidyne, however, this armature flux is utilized to good advantage.

If the load resistance now be made negligible by short-circuiting the armature it is found, say, that only one volt is required in order to circulate 100 amp in the armature. (One hundred amperes short-circuit current is used for purposes of discussion. Practical amplidynes use values of between 3 and 20 amp.) Inasmuch as output voltage is proportional to field excitation, and vice versa (neglecting saturation) it is seen that only one watt field excitation is now required as compared with the 100 watts required before the armature was short-circuited.

The power output of the machine under these conditions is 100 watts, so the armature to field power ratio of 100:1 has not changed. The important point is that, as formerly,

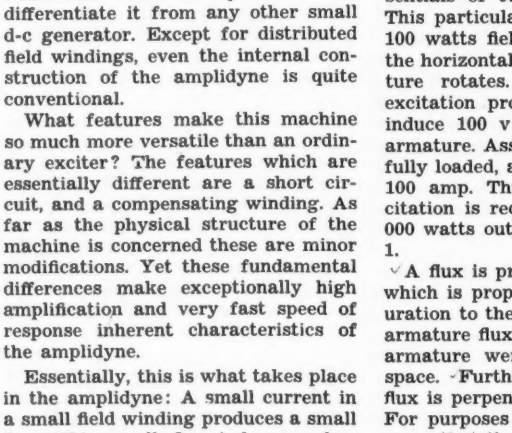


Fig. 1. Simplified Conventional D-C Generator showing flux and current relations

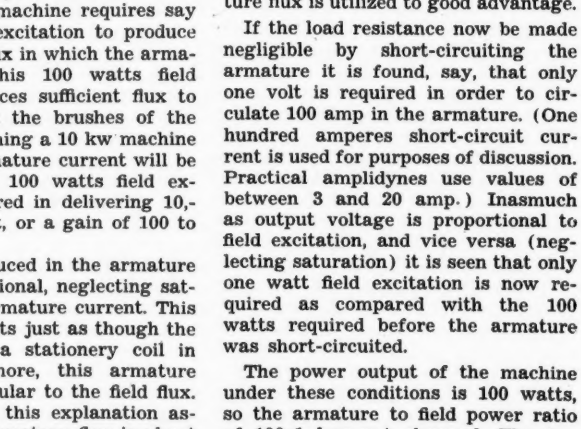

LOAD
ARM LOAD CURRENT FLUX
COMP FIELD FLUX
EQUAL AND OPPOSITE
COMPENSATING WINDING
SHORT CIRCUIT FLUX
SMALL CONTROL FIELD
NOTE: SMALL CONTROL FIELD FLUX REQUIRED TO PRODUCE HEAVY SHORT CIRCUIT CURRENT AND FLUX

Fig. 2. Simplified representation of flux and current conditions in an amplidyne generator

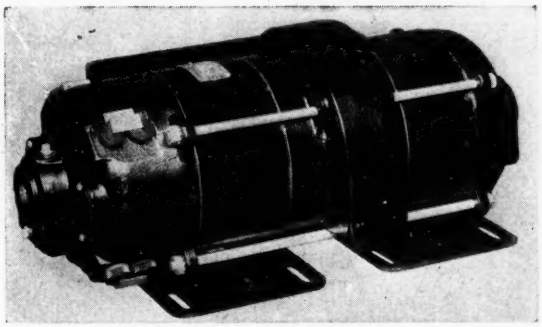


Fig. 3. Typical construction for amplidynes up to 300 watt ratings. Amplidyne shown at left, driving motor at right

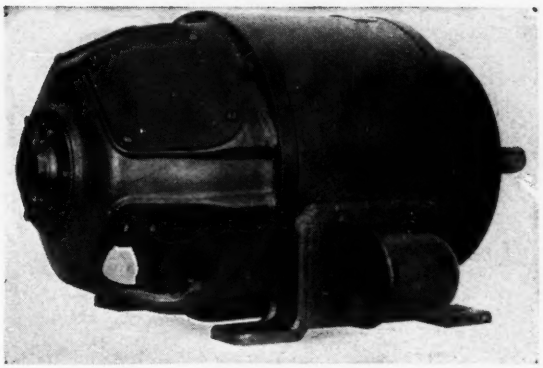


Fig. 4. Drip proof amplidyne generator, showing terminal box and front end

there is still 100 amp circulating in the armature. And this 100 amp armature current is producing a flux which is equal in magnitude to the field flux formerly produced by 100 watts of field excitation.

Even after reducing the field excitation from 100 watts to one watt, but by short-circuiting the armature, the original large armature flux is available. Furthermore, since the field flux has to build up to such a low value, and since resistance and reactance of the short-circuited armature are very low, full load current will be obtained in an exceptionally short time. This is one of the reasons for the fast speed of response of an amplidyne.

Add Second Pair of Brushes

At this point another pair of brushes is placed on the commutator. This second set of brushes is placed so that the brushes will lie in the neutral axis of the armature flux, or saying it differently, the axes of the two sets of brushes will be perpendicular (Fig. 2.).

Now the same relationship exists between the secondary brushes and the armature flux as formerly existed between the main flux and the single set of brushes. If a voltmeter is connected to the secondary brushes it will be found that a potential of 100 v is available. If the same load as was used with the conventional generator is now connected to the secondary brushes a current of 100 amp will flow. This 100 amp will produce a flux of its own on which will have the same axis as the field flux. But, the load current flux is approximately 100 times greater than the field flux. This state of affairs very quickly renders the control influence of the field ineffective.

By adding a compensating field winding to the machine it is possible to neutralize the load current armature flux. This winding is connected in series with the armature and the load. It is of course necessary that the winding, or windings as the case may be, be designed so that regardless of the value of load current the compensating winding always produces a flux which is exactly equal and opposite to the flux produced by the load current in the armature.

With the addition of the compensating winding the machine becomes an amplidyne generator. Figure 2 is a very simplified representation of an amplidyne generator. Note the distinguishing features of the machine: very small control field, a short-circuited armature, and a compensating winding.

It is very interesting to note how amplification has been effected. The excitation power in the field is one watt. The power output of the machine is 10,000 watts—a ratio of 10,000:1 as compared to a ratio in the conventional machine of approximately 100:1.

Before going further it may be well to discuss in more detail some of the more important physical and electrical characteristics of the amplidyne.

Generally speaking, standard amplidynes are available in two different types of construction. The type of construction is determined by the size of the machine. Up to ratings of about 1500 watts the machines are built as an integral unit with an induction motor on the same shaft and in the same housing. Figure 3 shows an amplidyne motor-generator set of this type.

Larger machines, which are built in standard ratings up to 25 kw, but which have been built as large as 60 kw are constructed as an individual unit. A unit of this type may employ a driving motor of its own or it may be one of several machines driven by a common motor. Figure 4 is a photograph of a dripproof amplidyne generator, 5 kw, 1750 rpm, 250 v, 20 amp.

There are certain characteristics, however, which are common to both types of construction. The usual amplidyne generator consists of a standard lap-wound, two-pole armature; a brush rigging carrying four brush studs equally spaced with brushes set trailing; a stator structure carrying the stator punchings and windings; and two standard ball-bearing end shields.

The above mentioned features are best depicted by views of disassembled machines. Figure 5 is a picture of a disassembled small amplidyne motor-generator set, such as is shown in Fig. 3. Figure 6 is a similar picture of the amplidyne shown in Fig. 4.

The stator usually contains from one to four control fields, a short-circuit-axis series winding, a load-axis compensating winding, and a load-axis commutating winding. It has already been explained that the control fields are the excitation windings of the machine. Their functions are similar to those of the shunt fields on conventional d-c generators.

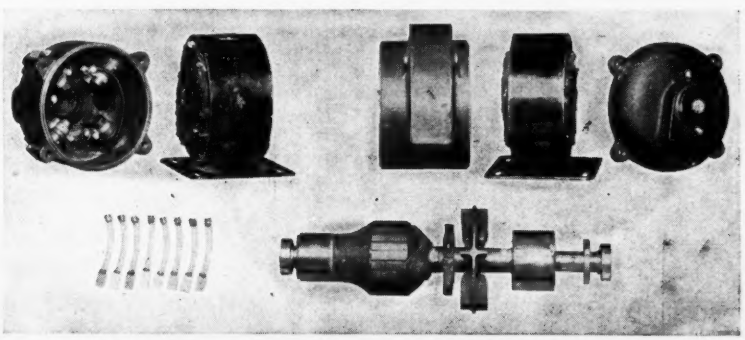


Fig. 5. View of machine shown in Fig. 3, disassembled

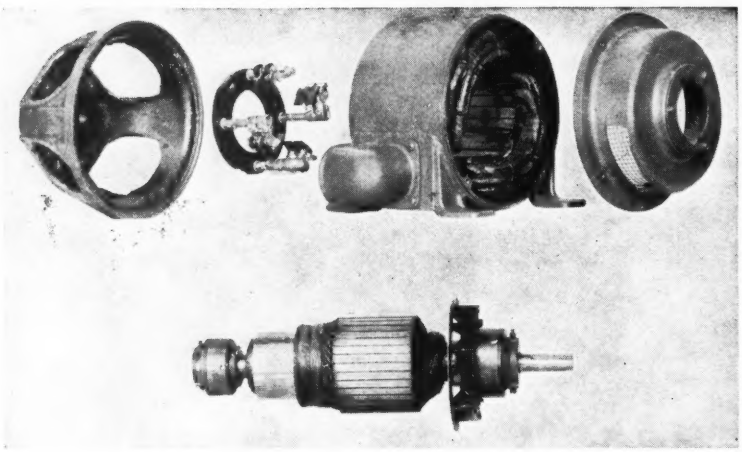


Fig. 6. View of amplidyne shown in Fig. 4, disassembled

The short-circuit-axis field windings are connected in series with the short-circuit axis brushes. The function of these windings is to assist the armature in producing the short-circuit flux. It has already been explained how the load axis compensating field windings serve to produce a flux which is equal and opposite to the flux produced by the load current delivered by the machine.

Excitation Required

A typical 10 kw, 1750-rpm amplidyne generator requires a net control field excitation of 80 amp turns to deliver full load at full voltage. A typical control field winding might be one of 400 turns and 75 ohms. A field of 400 turns would have to carry 0.2 amp in order to produce 80 amp turns. This would mean a power consumption of three watts in the field in order to deliver 10,000 watts. The field of a conventional generator of this size would probably consume 200 watt or more.

Most amplidyne applications are such that the machines are not used at over 80 per cent rated voltage. Eighty per cent voltage is usually the limit of the straight portion of the saturation curve. Reduction of operating voltage from 100 per cent to 80 per cent reduces the required field amp turns by one-half.

Under normal operating conditions the amplidyne generators will deliver rated current at a maximum over-voltage of from 10 to 20 per cent. This higher voltage limit is necessary to secure fast response by forcing methods.

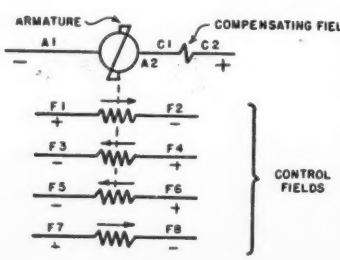


Fig. 8. Conventional amplidyne symbol

Amplification and Speed of Response

Amplification is ordinarily defined as the ratio of output volt-amperes to input volt-amperes. By speed of response is meant the time required for the armature load voltage to reach its operating value after the application of control field voltage. The applied control field voltage in this case is the voltage required to excite the amplidyne to whatever output voltage has been selected.

Amplification and speed of response are very closely interrelated. Generally speaking, it is safe to say that for a given design, an increase in speed of response will result in a decrease in amplification, and vice versa. It is also true, as found in radio, that by amplifying in several stages, amplification increases in geometric progression without a sacrifice in speed of response.

The amplidyne is essentially a two-stage amplifier. The first stage of amplification is from the control field to the short-circuited brushes, and the second stage is from the short-circuited brushes to the load brushes. This feature of the amplidyne makes possible greater amplification and faster speed of response than can be had in a comparable d-c generator of the conventional type. There are also other factors which effect the amplification of an amplidyne generator. The control field power required to produce the short-circuit current varies relatively little, regardless of the size of the amplidyne. Other things being equal, therefore, the larger the amplidyne the greater the amplification. Operating an amplidyne at reduced loads and on the straight portion of the saturation curve also makes for greater amplification. The amplification of the amplidyne is from 5000 to 10,000. These are conservative values. Some new designs allow an amplification of 1,000,000/1 to be obtained in the amplidyne itself by feeding back from one stage to the other. This high amplification, of course, results in a decrease in speed of response.

An amplidyne rate of response is shown in Fig 7. Curve A shows a 60-cycle timing wave and the control field current. Curve B shows the short circuit axis current, and Curve C shows the load or output voltage. In this test the control field voltage was applied instantaneously. The control field current did not build up instantaneously because of the inductance of the control field. Nevertheless, the oscillogram shows that both the short-circuit axis current and the load voltage are very nearly in phase with the control field current. Examination of the oscillogram of Fig. 7 reveals that the over-all time constant is three cycles, or one twentieth of a

(Continued on page 133)

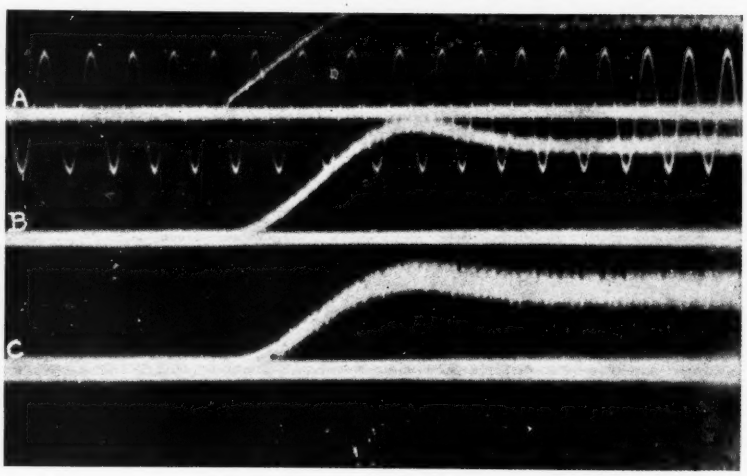


Fig. 7. Response of an amplidyne generator to control transients. A. Control field current, 60 cycle timing wave. B. Short circuit, axis current. C. Load voltage

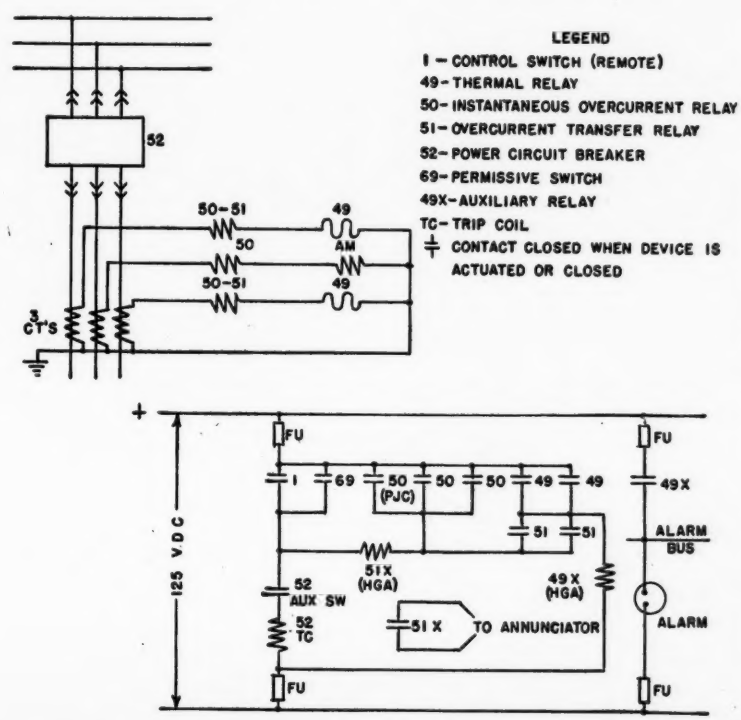
Combination Alarm and Stalled Rotor Trip for Motors

By P. E. BENNER General Electric Co.

PRACTICE varies among operators regarding the method of protecting auxiliary motors from damage due to overload. Some prefer to use only an alram and depend on the operator to trip the motor in the case of sustained overload. Others prefer to automatically trip the motor in case of overload, and thereby to minimize the possibility of damaging the motor. Admittedly, the alarm is of no advantage in the case of a stalled rotor inasmuch as there is not sufficient time to allow an operator to locate the motor and trip it off before it is damaged. Stalled rotor protection must, therefore, be automatic if it is to protect the motor against damage.

Service continuity is of maximum importance in designing the control for auxiliary motors. There is of necessity some margin between the thermal characteristics of protective relays and the thermal capacity of the motor. The desire to use the full thermal capacity of essential auxiliary motors is the reason some operators prefer not to automatically trip the motor in case of overloads. On the other hand, some operators who have experienced the serious consequences of burning out the motor for an essential auxiliary feel that taking this chance is not in the interest of greatest service continuity.

The accompanying diagram shows a combination scheme which gives an alarm on overload and trips on stalled rotor. The scheme as shown includes thermal relays energized from current transformers and overcurrent relays which transfer the thermal relays from the alarm to the trip circuit upon the occurrence of excess current (2 or 3 times normal). The scheme also includes instantaneous overcurrent relays to provide short circuit protection (10 times normal).



Typical auxiliary motor feeder circuit and diagram of trip circuit

In case of 2300 v gear, the only extra equipment required to provide combination overload alarm and stalled rotor trip are two type PJC instantaneous overcurrent throwover relays and one HGA auxiliary relay (device 49X). The three instantaneous overcurrent relays, the thermal relays, the current transformers and the HGA auxiliary relay (51X) would be required for straight overload alarm or trip protection. In the case of low voltage (600 v and below) switchgear, the following additional equipment would be necessary:

2—Current Transformers
2—Thermal Relays
2—PJC Instantaneous Overcurrent Throwover Relays
1—HGA Auxiliary Relay (49X)

Cost would probably not be a factor in selecting the type of protection used where 2300 v switchgear is involved inasmuch as there would be negligible difference between the various schemes of protection. In the case of low voltage gear, however, the additional cost for the combination protective schemes over the cost of either straight overload trip or overload alarm would be appreciable both with respect to the cost of switchgear itself and the motors to be protected. It is estimated that this additional cost would be in order of $300 or $400 per breaker position.

G. E. BUILDS FIRST GAS TURBINE FOR UTILITY

FIRST GAS TURBINE for an electric utility is under construction at the General Electric Co.'s Schenectady Works and will be shipped to the Southwest early in 1949.

A duplicate of the 4800-hp locomotive gas turbine first publicly announced in March and now undergoing tests, the 3500-kw turbine generator set was purchased by the Oklahoma Gas and Electric Co. It will be installed at the Arthur S. Huey station, Oklahoma City, in an extension to the present station. Natural gas which is available in abundance in the area, will be the fuel. The waste heat from the exhaust will be used with a separate heat exchanger to supplement the present boiler feed water heating system. This will increase station output by releasing part of the heating load.

The "straight-through" or in-line arrangement of the compressor, combustion chambers, and turbine was selected for this application. The unit has been designed for maximum accessibility during maintenance and inspection periods.

The new gas turbine will be geared to a conventional 3600-rpm totally enclosed generator with direct-connected exciter. The only water required in the operation of the plant will be a small quantity for cooling the bearing lubricating oil and for cooling the a-c generator.

Standard Builds 1250-Psi Topping Plant for Whiting Refinery—II

By D. A. MONRO
Chief Engineer
Standard Oil Co. (Indiana)

and

A. T. MILBROOK
Assistant Chief Engineer
Whiting Refinery

AS DESCRIBED in Part I of this article, April 1948 issue, the initial installation in the new 1250-psi topping steam plant for the Whiting, Indiana refinery of Standard Oil Co. (Indiana) consists of three steam generating units each with a capacity of 300,000 lb per hr of steam at 1350 psi, 900 F; two 10,000-kw turbine generators; and two hot-process softener units. General design and arrangement of the station are as described in Part I.

One of its most interesting features is the dual-circulation steam generating units[1] described below. These were designed and selected because of the requirement for boiler operation at high pressure on essentially 100 per cent make-up with minimum blowdown. Reasons for the high make-up, also the source of boiler feedwater, were given in Part I.

While the reduction in blowdown made this unit economically attractive, it was the ability to operate with low boiler water concentration in the highly-heated tubes and resultant low silica contamination in the steam that greatly influenced its selection. A considerable portion of the steam supplied to the refinery by the 1250-psi topping turbines will pass through a large number of 400-psi and 100-psi refinery steam turbines, hence silica contamination must be reduced to an absolute minimum.

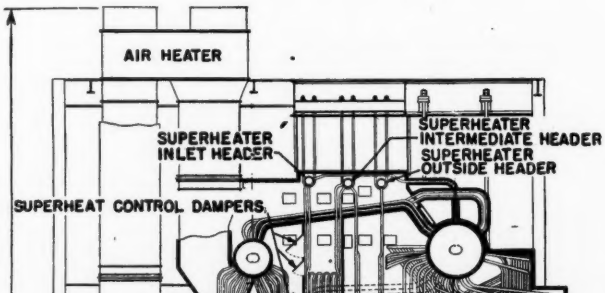
Steam Generating Unit Has Two Heat-Absorbing Sections

The unit resembles a conventional three-drum boiler but is actually divided into two separate heat-absorbing sections, each with its own independent circulation system: primary, or high duty section, comprising the strongly-heated radiant heat-absorbing furnace; and secondary, or low-duty, section, the convection section of the boiler in which rate of heat absorption is relatively low.

All feedwater enters the primary section and all steam is delivered from it. Continuous blowdown from this section feeds the secondary section and steam generated in the secondary section is condensed in the primary. Total blowdown leaves the unit from the secondary section.

Boiler feedwater at 240 F is introduced into the 72-in. main drum of the primary section, where it is heated by direct contact with the steam produced in the secondary section. The water then passes into the main body of the drum from which it is carried through multiple pipes distributed along the drum to two large external downcomers and thence to the water headers at the bottom of the furnace. Independent circuits for each corner tube and for adjacent pairs of tubes insure positive circulation in the portions of the water walls having relatively low rates of heat absorption. All flow in furnace wall tubes is upward.

The mixture of steam and water leaving the wall tubes passes through



Cross-section of one of the three dual-circulation steam generating units supplied by Foster Wheeler Corp. for Whiting topping plant

Each unit has capacity of 300,000 lb per hr continuous output, delivering steam at 1350 psi, 900 F at superheater outlet. Units are designed for firing with pulverized coal, fuel oil and refinery gas, only the two latter to be initially fired. Furnace designed for unusually low heat rate of 13,700 Btu per cu ft per hr

[1]Principles and details of the dual-circulation steam generating unit and its design to reduce blow-down losses were given in a paper Steam and Power Generation in the American Refinery, by W. F. Ryan, Assistant Engineering Manager, Stone & Webster Engineering Corp.; *Oil & Gas Journal*, June 20, July 6, 13, 20, 1946; subsequently republished in *Heat Engineering*, No. 7, 1946. — The Editor

[2]Steam Turbine Blade Deposits — F. G. Straub, *Bulletin No. 364*, Engineering Experiment Station, University of Illinois, 1946.

washing and separating compartments in the primary drum. The most highly concentrated water in this drum is then carried by external circulating tubes to the upper drum of the secondary section, is the feed for this section, constitutes the continuous blowdown from the primary section, and because of its magnitude with relation to the steam output of the unit, results in a low boiler water concentration in the primary section. The feed to the secondary section is the sum of the steam produced in the secondary section and the blowdown from the unit.

Boiler Water Concentration

Because of the relatively low rate of heat input to the convection bank, the boiler water concentration that can be maintained in the secondary section is much higher than that permissible in the furnace tubes. Consequently the blowdown rate from the unit and resultant heat loss can be greatly reduced compared to the blowdown that would be required in a conventional unit. Also, danger of furnace tube failures is minimized by the low concentration in high heat transfer areas.

Silica carryover in the steam, as shown by Prof. F. G. Straub,[2] depends on silica concentration in the boiler water, pressure, and pH of boiler water. If the pH of the boiler water is maintained at a satisfactory level, the dual-circulation principle results in a minimum production of silica vapor, first, because of the steam generated in the secondary section from highly concentrated boiler water is completely condensed in heating the incoming feedwater, hence contributes little, if any, silica to the steam leaving the boiler; second, the steam leaving the boiler is produced in the primary section where the boiler water concentration is low.

Carry-over of solids in steam for blowdown percentages from 1 to 30 per cent, in the dual-circulation boiler, ranges from 0.45 ppm down to 0.31 ppm. Silica in the steam, for blowdown ranging from 1 to 30 per cent, ranges from 0.030 down to 0.021. These values are well below the value of 0.1 ppm, at which turbine silica deposits do not form.

Steam temperature control is by means of dampers in the gas pass between the second section of the superheater and the convection section of the boiler. With the type of feedwater available, the heat-exchanger type of superheat control is not feasible because of the danger from deposits. Continuous blowdown is from the upper drum of the convection section with intermittent blowoff from the lower drum and from the lower ends of the primary section downcomers.

Breaker Interrupts 7½ Million KVA

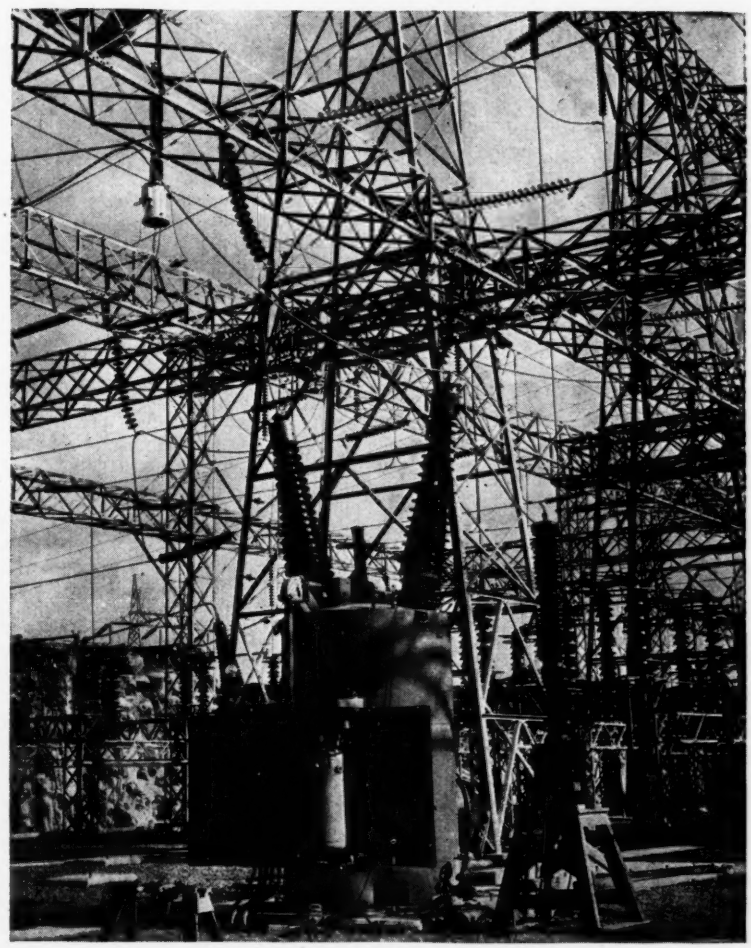
A NEW WORLD'S RECORD has been established in short circuit power handled by a high-voltage circuit breaker.

The entire output of the six 108,000-kva generators at Grand Coulee Dam, together with back feed over six 230-kv transmission lines from the onneville Power Administration system and the Northwest Power Pool, was poured into tremendous short circuit test recently on a new Westinghouse oil circuit breaker. The fault power approximated 7,500,000 kva on a 3 phase basis and was interrupted successfully twice within a 15 second interval.

Additional tests under the same system conditions demonstrated the ability of this 230-kv breaker to reclose its contacts within 0.3 seconds or less, and then interrupt a second time whenever the fault was found to be permanent.

A total of 35 fault interruptions was made, 12 of which were with full system capacity and all generators. Due to the rapid breaker action, 3 cycles or less, the disturbance to the system was negligible, and no load was lost.

Engineers of the Bureau Reclamation and the Westinghouse Electric Corporation cooperated in these tests for the purpose of developing higher capacity circuit breakers to be used in the ultimate switching installation at Grand Coulee Dam. W. H. Clagett, N. G. Holmdahl, A. P. Newbury, A. C. Conger, C. L. Kilgore and W. G. Sieglin, of the Bureau of Reclamation, conducted the tests. The demonstration was supervised by W. M. Leeds, R. O. Bonine, G. B. Cushing, C. J. Tirk, D. M. Umphrey and D. J. Marsden for Westinghouse. For Bonneville Power Administration, H. L. Levinton, A. W. Adams, and Howard Ashe observed the tests.



Westinghouse 3-cycle oil circuit breaker which interrupted a 7½ million kva short circuit on a 230 kv bus at Grand Coulee Dam

Fig. 1. There are four rows of blading in the cast iron section of this steam turbine cylinder. Shown at points A and B are the areas of greatest wear

Repairing a Steam Turbine Cylinder

In one month this municipal plant completely rebuilt part of the steel section and all of the cast-iron section of one of its steam turbine cylinders . . . Replacement, at the time, was out of the question because of the high cost and unavailability of parts . . . Complete dismantling and inspection was made possible during the down-time

By J. C. BLANKENSHIP,
Superintendent of Power Plants, Austin, Texas

THE POWER supply of the City of Austin, Texas, is a combination of purchased power and power which is supplied by the City's steam generating station. The electric load, differing from that of Northern cities, is much heavier in summer than in winter due to the exceedingly high demand made by refrigeration and air conditioning plants in the hotter parts of the year.

There is a distinct advantage to the City in keeping the steam plant at its full capability because, under the best of conditions, this capability is less than the load and difference must be made up by purchased power.

In one of the 9375 kva turbine generator units, the cylinder had become so badly worn that replacement or repair was necessary. At the time, replacement could not be considered because of the high cost and the uncertainty of delivery. It was, therefore, decided to arc weld the cylinder and finish it by grinding.

The machine was taken out of service in February, 1947 and it was returned to service in March, 1947. During the outage a complete dismantling and inspection job was undertaken under the supervision of the turbine manufacturer's service engineer.

There are two parts to the cylinder. the high pressure section is made of steel and the low pressure section is of cast iron. There are four rows of blading in the cast iron section. It was necessary to weld the cylinder for the blading in the cast iron section and the last eight rows in the steel section because of the extreme wear. This wear is apparent in Fig. 1.

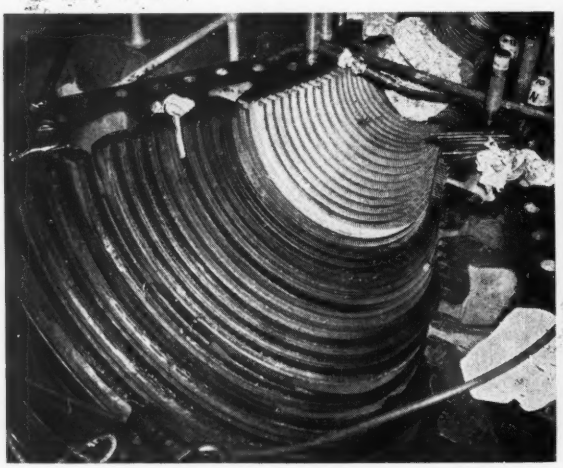


Fig. 2. Before welding, the entire steel section of the turbine cylinder was cleaned, chipped and brushed

Fig. 3. After the cast iron section was cleaned and chipped, small holes were drilled for the insertion of steel pins

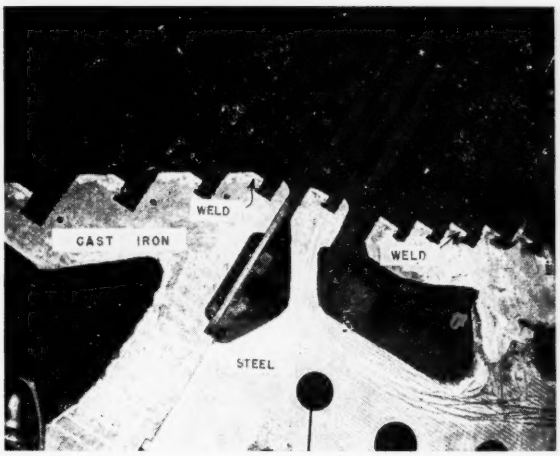


Fig. 4. This photograph is a view almost comparable to the one shown in Fig. 1. Note how the cast iron section has been rebuilt to its former shape. Lighter areas are weld metal

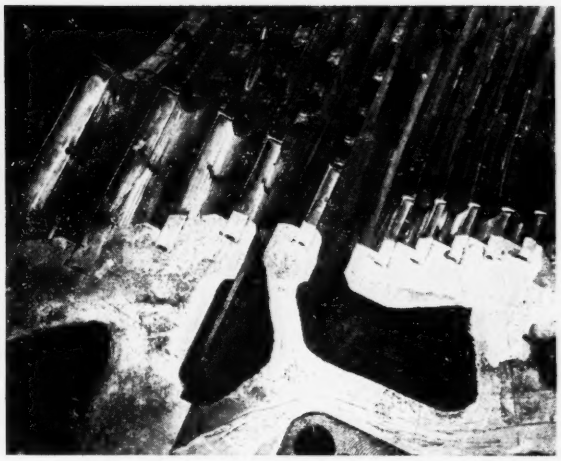


Fig. 5. After welding, the cylinder was ground to the dimensions specified by the manufacturer. This view is the same as Fig. 4 but the blades have been replaced

Before welding, the steel section was cleaned, chipped and brushed. This is shown in Fig. 2. The cast iron section was cleaned, chipped and drilled for small steel pins; these pins are shown in Fig. 3. Also shown in this photograph is the method of holding the coppers in place after they were inserted in the blade grooves. The welding has covered the pins in two rows of the blading at the right in the photograph.

After welding, the cylinder was ground to the dimensions which were determined by the manufacturer. After the machine was returned to service it was found that its operation had been considerably improved.

This paper was presented in the 1947 "Design for Progress" competition conduced by The James T. Lincoln Arc Welding Foundation.

MOUSE TRAPS DEMONSTRATE NUCLEAR FISSION

NUCULAR FISSION, the atom-splitting chain reaction which makes the atom bomb work, is being demonstrated daily in high schools and universities throughout the United States with the use of mousetrap models.

The equipment consists of some 50 to 75 mouse traps, twice as many small rubber balls or corks, and some chicken wire.

In the chain reaction, a neutron interacts with the nucleus of a uranium atom to form more than one neutron. If each of these several neutrons produced in the original fission in turn produce another reaction, more neutrons and fissions will originate, just as rabbits multiply with each generation.

With the mouse trap model, the small rubber balls represent neutrons, and the mouse traps, uranium or plutonium atoms. The balls are carefully placed on each mouse trap, two per trap. The entire model is then framed in the chicken wire or enclosed in a glass case, care being taken to provide ample space in which the balls may bounce around.

Just as a neutron must be "thrown in" to start nuclear fission, one ball is tossed in to set off the mouse trap model. When the ball hits a mouse trap, it snaps shut, the balls resting on it fly off and land on other traps. These snap shut, sending off other balls, until the supply is exhausted.

The idea of critical mass is also demonstrated. There must be enough mousetraps so that the balls thrown into the air by a single trap spring at least two others. If there are not enough traps, some balls will miss and the reaction will fail—as in an atom bomb which carries an insufficient charge.

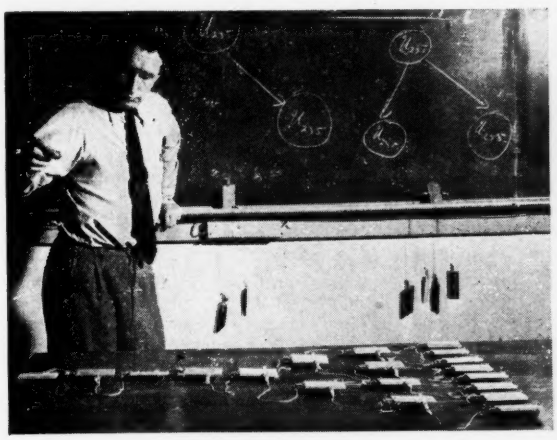


Fig. 1. To represent an uncontrolled nuclear reaction, Dr. Van der Grinten has one mousetrap tied to two more, each of these tied to two more and so on

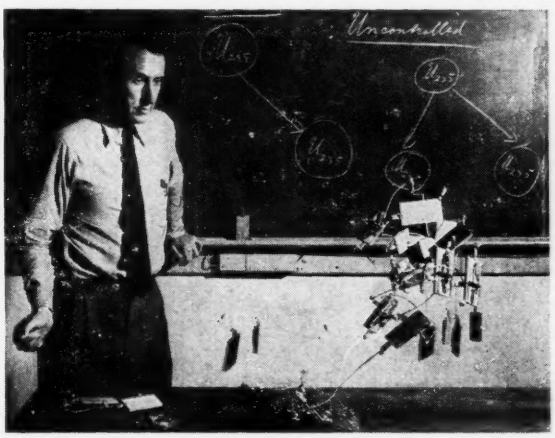


Fig. 2. Here the model of the uncontrolled chain reaction, which occurs in the atomic bomb, is going off, apparently much to Dr. Van der Grinten's astonishment

The Midwest Power Conference

Tenth Annual Midwest Power Conference held at Chicago devoted considerable time to a discussion of the fuel situation and gas turbine developments. Flood Control, Power Plant Operator Training, System Operation and industrial power plants were other subjects discussed

THE TENTH Annual Midwest Power Conference was held in Chicago, at the Sheraton Hotel, April 7, 8 and 9. As in previous years the technical program covered a variety of interests, the papers, for the most part recounting the status of the various branches of the power field. Whether by design or chance, it seemed that the principal purpose of the technical papers presented at this conference was to acquaint an engineer working in one branch of the field with what is going on in another. As an example, the paper on power stability presented by Professor Kimbark of Northwestern University was of little value to the power system engineer but it was of considerable interest to those not directly concerned with power system operation since it explained the basic principles involved in power system stability.

The three-day meeting opened with an address of welcome by D. D. Ewing, Head of the School of Electrical Engineering, Purdue University. Professor Ewing's address was brief; he stressed the importance of *power* in our civilization, the average citizen's bland acceptance of it, and its growth. Last year's 225 billion kilowatt hours, he pointed out, is 10 per cent above the 1946 output; the 174 billion kilowatt hours generated in steam plants required the equivalent of 114 million tons of coal. From the standpoint of conservation of natural resources, he said, this gives us something to think about. The physical assets of the power industry per employee are high compared to other industries. In many large industrial enterprises the *tools* investment per employee is well under $5000. For the public utility companies of this country, Professor Ewing said, the average is somewhat over $50,000. This high figure points to the need of superior technological training for employees in this industry.

Professor Ewing's opening address was followed by a discussion of American industry's future power needs by F. R. Benedict of Westinghouse Electric Corporation. The amount of installed horsepower per worker, Mr. Benedict said, had grown from about 1.3 in 1879 to a present value of 7.2. If we are to progress as a nation, our productivity must increase, and to do this even more horsepower must be placed behind the worker. Following this general introduction, Mr. Benedict then considered a number of specific industrial operations—welding and brazing, infra-red heating, factory lighting, ore benefication, mining, etc—indicating in each case the probable future power requirements. The total so arrived at is quite staggering and it set one to wondering just how it is all to be brought about. Even now, with all manufacturing plants working at top capacity it is almost impossible to keep up with just the normal growth in load.

Flood Control and Power in The Southwest was the title of the third paper presented at the opening general session. This paper, presented by Edwin Vennard of the Middle West Service Co. discussed the underlying philosophy in flood control procedure. He stressed the difference in construction between a dam intended primarily for flood control and one intended for both flood control and power generation. The whole question is related to the sale of power from hydroelectric projects—to the extent that the government should enter into the power business. This being so, there is considerable emotional thinking involved in the problem.

The opening session concluded with an address by John M. Drabelle, Chief Mechanical and Electrical Engineer of the Iowa Electric Light & Power Co., entitled, The Trek of Industry Westward.

Those attending the conference were especially interested in the various papers and discussions on the fuel situation and also gas turbine development.

These two subjects are intimately related as many of the speakers indicated.

The paper presented Wednesday afternoon by John Van Brunt emphasized the importance of coal as our basic fuel. Increasing demands for oil and gas fuels in the face of their limited supply in the foreseeable future make it necessary to look to coal for the bulk of our energy. Van Brunt showed various estimates of fuel reserves which according to some may last from 1500 to 2000 years. But if for mechanical and economic reasons only 50 per cent of this coal can be recovered and shipped the reserves will last less than 1000 years. Even so on the most conservative basis, our oil and gas reserves are only 5 per cent of the total. Estimates of future progress indicate that we may need to produce over 800,000,000 tons of coal produced in 1947.

One discusser of this paper pointed out that engineers should get together on some basis of economic and social policy and convince society that it should stop throwing 70 per cent of the coal away in the condenser circulating water. Engineers know and can devise methods for preventing much of this waste if permitted to do so.

One method being studied to solve the fuel problem is underground gasification of coal discussed by W. C. Schroeder of the U. S. Bureau of Mines. Mr. Schroeder explained the experiment already made in this country as reported in the September 1947 issue of POWER PLANT ENGINEERING and said that a second experiment would be started this summer. Coal burned underground with the object of producing: (1) pipeline gas for fuel and process, (2) fuel for gas turbines, and (3) gas for synthesis into liquid fuel. The problems are those of controlling and confining gas formed by underground burning, increasing its heating value by the use of steam and oxygen.

In the second experiment in underground gasification, new methods of vertical and horizontal drilling in the coal seam will be tried.

A. D. Singh reviewed his method of

fluid devolatilization in fluidizing of coal as explained in the October 1947 issue of POWER PLANT ENGINEERING. Mr. Singh emphasized that it provided another method for treating coal as a raw material and recovering from it not only gas but also a char suitable for burning in the cyclone burners, tar for fuel or other use and reduction of the sulphur problem. This process also leads to the manufacture of synthesis gas for conversion into liquid fuels. He showed that this process can yield gas and fuels, at present costing only a little more than the present cost of gas, and the latter is going up.

A session that was of particular importance to power plant operators was the session on Thursday afternoon on power plant operator training programs. This session was sponsored and arranged by the National Association of Power Engineers. The speakers were Kenneth R. Hodges, Editor of *The National Engineer*, Chicago; Julius Barbour of East Lansing, Michigan; Garrett Burgess of Detroit, Michigan; and Stephen P. Casteel of East St. Louis, Illinois. All of these speakers told of their experience in formulating operator training programs. All of them emphasized the importance of these programs and pointed to the savings that could be made by having operators properly trained in their work. This session evoked little discussion but the vigorous comments by Joe Harrington gave the meeting refreshing stimulus. Mr. Harrington pointed out that while he agreed 100 per cent with the speakers in that operator training was necessary, he felt that what was even more important was to educate those at the top. As he pointed out, unless top management can be educated and convinced that operator training programs are necessary and that operators should be given the proper tools for effecting savings, all work in trying to train operators is more or less lost. Mr. Harrington said that it was not merely sufficient to establish operator training programs, what was necessary was to glamorize education, to give it the new look that would make operators want the education.

In the discussion of the gas turbine by P. R. Broadley, C. F. Kottcamp and J. I. Yellott much emphasis was placed on the importance of the coal burning gas turbine in utilizing coal directly without conversion into synthetic oil or gas at greater costs. Mr. Broadley reviewed the physical design of the two coal burning gas turbines, the Baldwin-Elliott and the Allis-Alco units now on order for the Locomotive Development Committee.

In developing these locomotives they are to compete with the Diesel in maintenance and availability. If oil had to be used and continues to be used in Diesel and gasoline engines stock piling of steel for oil reserves and tankers is a factor. The railroads want self-contained, electric drive locomotives and gas turbine locomotives will duplicate the Diesel in size and auxiliaries except for the prime mover. Kottcamp and Yellott discussed progress in the last few months. The design is essentially as that shown by Yellott in his series of articles in POWER PLANT ENGINEERING during the past year. New developments are that the raw coal will not be pulverized in the storage bunker but by means of a new form of coal pump will be put under pressure before it goes to the jet pulverized or coal atomizer. The small amount of fly-ash collected from the gas ahead of the turbine will be stored in a tank at atmospheric pressure.

The locomotive will carry a small Diesel set to supply turbine starting power and drive the locomotive cab slowly when the gas turbine is shut down. Since the gas turbine exhaust gas temperature is about 800 F. it must be shut down before running into a repair shop.

Full scale tests of combustors at Dunkirk and Fontana previously reported appear very promising. At the Fontana, the combustor was operated at 100,000-cfm at 45-psi and about 3000 lb of coal per hr. There was very little deposit on the combustor interior. Combustion efficiency was from 83 to 90 per cent.

The Diesel is the most economical prime mover. Usually the Diesel runs about 10,000 Btu per horsepower hour, the coal fired gas turbine about 13,000 Btu per horsepower hour, and the coal burning reciprocating steam engine locomotive about 38,000 Btu per horsepower hour. Broadley said that gas turbines were expected to be delivered for these locomotives in September 1948 and perhaps the locomotives would be on the rails for testing almost a year and a half from now or about October 1949.

The electrical end of power plant design and operation was covered in a number of papers presented at the conference. One of considerable interest was that delivered on Wednesday afternoon by Everett S. Lee of the General Electric Co. on the electrical measurement of non-electrical quantities. This was a very comprehensive paper and it listed a great variety of measurements which are made by electrical means.

Other electrical papers discussed the measurement of power and power factor in industrial plants, high power D-C distribution systems, the excitation requirements and control of reactive power, rotating regulator exciters, the problem of rural electrification from the power company viewpoint, application of oil reclosers on distribution systems, rectifier power supplies for D-C system and a variety of other papers which we have not room to list here. Of considerable general importance were two papers, one describing the Japanese electric power system and the other the power situation in Europe described by Walker L. Cisler of The Detroit Edison Co. Mr. Cisler gave an extensive review of the transmission system in Europe and outlined the proposed new construction under the Marshall Plan.

Walter Richter of Allis Chalmers presented a very interesting paper on circuit principles of industrial electronic control. Mr. Richter pointed out that there still seems to be a feeling among many electrical engineers that electronic control is something altogether different from the established and time honored types of control. However, examination of the diagram of an electronic control will disclose a good many more resistors, capacitors, inductances, etc. all well-known electrical components, than tubes. Just one new component has been added in these controls, but this does not invalidate the circuit laws pertaining to the other components. With this introduction, Mr. Richter proceeded to discuss various kinds of tube in terms of substitutes, switches, relays, etc. It was an excellent paper and gave power engineers much to think about.

Another paper that was of considerable interest to the electrical men at the conference was the paper on the development of requirements for copper wire connections by Frank E. Sanford, director of research and development of the Copper Wire Engineering Association. This paper was based on a laboratory investigation conducted by Armour Research Foundation of Illinois Institute of Technology, and considered the mechanical aspects of electrical connections. Mr. Sanford's consideration of the nature of surface films and the mechanism of oxide formation was of particular interest.

ATOMICS

A New Section added to POWER GENERATION to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

Mesons Produced by U. of California Cyclotron

Mesons, nuclear particles heretofore found only in cosmic rays have been artificially produced for the first time by means of the 184-in cyclotron at U. of California. This development is regarded by scientists as the most significant event in fundamental research since the discovery of nuclear fission —one of the great milestones of all time in fundamental nuclear science

By ANDREW W. KRAMER Editor, Power Generation

ONE of the mysterious things about the nucleus of the atom is the manner in which the protons are held together. Protons, we know are charged particles — particles of approximately the same mass as the neutron but carrying a positive electrical charge.

Many years ago Coulomb found that the force between two charges is directly proportional to the magnitude of the charges and inversely proportional to the square of the distance between them.

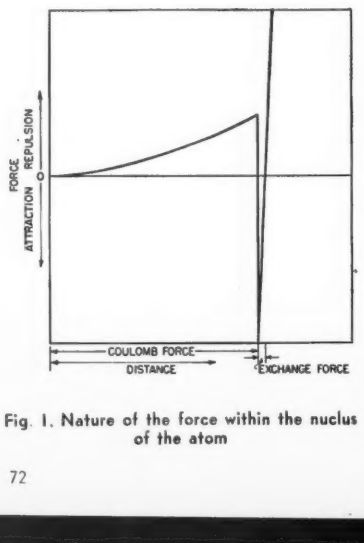


Fig. 1. Nature of the force within the nuclus of the atom

Thus:

$$F = \frac{e_1 e_2}{r^2}$$

If e_1 and e_2 have the same sign F is positive, whereas if they have opposite signs F is negative. Consequently a positive value of the force indicates repulsion, a negative value, attraction.

From this it is evident that at extremely short distances the repulsive force between two protons must be very great, yet, we know that in some cases (that of the uranium nucleus) as many as 92 protons are crowded together in the almost infinitesimally small volume of an atomic nucleus. Why is this? How can this fact be explained?

At the present time these questions cannot be answered but a great deal of work is being done in an effort to find the answers. Whatever the explanation, it is evident that dispite the working of the *Coulomb* force, at certain distances the force between the particles must be attractive, otherwise the particles would not associate in the nucleus as they do. At very much smaller distances the force must again be repulsive, otherwise the particles would approach each other infinitely close. (Fig. 1)

There is one thing that we *do* know and that is, that two or more protons cannot exist in a nucleus without the presence of at least as many neutrons as there are protons. In other words, *no nucleus is stable which contains more protons than neutrons.* There is only one exception to this rule; this is helium 3, (He^3) discovered in 1940 to be stable. The nucleus of this isotope of helium has two protons and one neutron in its nucleus.

Ordinary helium, ($_2He^4$) of course, has two protons and two neutrons in its nucleus.

It appears, therefore, that neutrons serve in some way to hold the protons together against their normal electrical repulsive force. Among the lighter elements—those listed at the lower part of the periodic table—the number of neutrons in the nucleus of the normal atom is approximately equal to the number of protons. As we go up in the scale of atomic weights, we find that the proportion of neutrons to protons increases. Thus, when we come to such elements as uranium, radium and thorium, we find a great preponderance of neutrons. Uranium 235, for example has 92 protons and 143 neutrons in its nucleus.

Neutrons are Necessary

Apparently, as the elements become more complex, additional neutrons are necessary in the nucleus to maintain stability. This stability is a rather delicate matter in some cases. In

the case of Uranium 235, as we have seen, the addition of a single neutron in the nucleus is sufficient to so upset the stability of the system that it suddenly explodes. This we have called atomic or *nuclear* fission.

In other cases the reaction is less violent but no less interesting or important. Whatever the controlling forces, these nuclear forces determine the nature of each nucleus in the same way that valence forces determine the combination of different elements into chemical compounds. Thus, carbon and oxygen can combine stably only in two ways, as CO and as CO_2. C_2O for example is not stable though it may have a fleeting existence and show its presence spectroscopically. Similarly, hydrogen always, that is, at normal temperatures, exists in the form of molecules of two hydrogen atoms. By the intense heat of the electric arc it is possible to dissociate these hydrogen molecules temporarily but in that form, as atomic hydrogen, it is unstable and as the temperature decreases, it recombines to form ordinary hydrogen.

If we examine a table of isotopes of the chemical elements we will find that certain numbers are not listed. In the case of nitrogen, for example, we find nitrogen 14 and nitrogen 15 but we find no nitrogen 13. This suggests that nitrogen 13 does not exist in nature- that it is unstable; and that proves to be correct. When Irene Curie and her husband Frederic Joliot bombarded boron $_5B^{10}$ with alpha particles, that is helium nuclei, $_2He^4$, they obtained the following reaction:

$$_5B^{10} + {}_2He^4 \longrightarrow {}_7N^{13} + {}_0n^1$$

where $_0n^1$ represents a neutron. This expression indicates that when boron is bombarded with alpha particles it forms nitrogen of mass 13 and a neutron. This form of nitrogen, however, is not found in nature and is highly unstable. It has 7 protons and 6 neutrons in its nucleus. One of the protons, therefore, emits a positive electron, changing it into a neutron. Thus, it becomes carbon 13 ($_6C^{13}$) which is stable.

Many similar instances of this kind could be cited, indeed, this sort of action underlies the whole great field of artificial radioactivity which has come into such prominence in the last decade, but they still would not explain, why the presence of the neutron is so important in maintaining the stability of the system.

There are, of course, a combination of forces at work in the nucleus to maintain its stability. First, there is the Coulomb force ($e_1 e_2/r^2$), second, there is the electromagnetic force (Hev) and thirdly we can assume that the gravitational force ($m_1 m_2/r^2$) also is present. These three forces, however, do not account for the way in which the protons are held together against the repulsive Coulomb force. There is probably present an *exchange force* of some kind, something not unlike the force that holds the two atoms of hydrogen together in the ordinary hydrogen molecule. The existence of this force is demonstrated by a wave mechanical treatment of the hypothetical process in which two hydrogen atoms, when not too far apart, exchange their orbital electrons in much the same manner that two boys, each possessing a ball, might throw the balls back and forth to one another.

This is shown in Fig. 3a. The hydrogen atom consists of a single proton around which revolves a single electron. The negative electrical charge of the electron, of course, exactly balances the positive electrical charge of the proton. The system, however, is not entirely balanced. For complete stability, two electrons are required in this orbit. In the helium atom, this requirement is fulfilled. There, the two positive charges on the

(Continued on page 124)

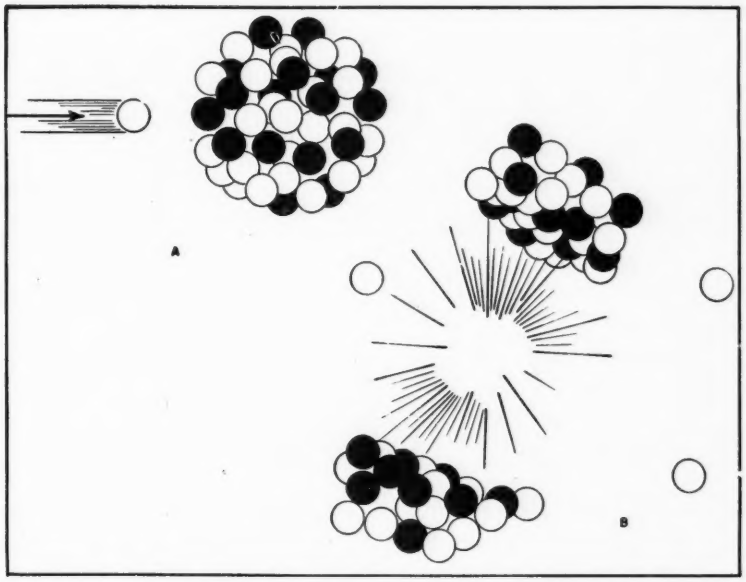


Fig. 2. When a single neutron is added to the uranium nucleus, it suddenly explodes.

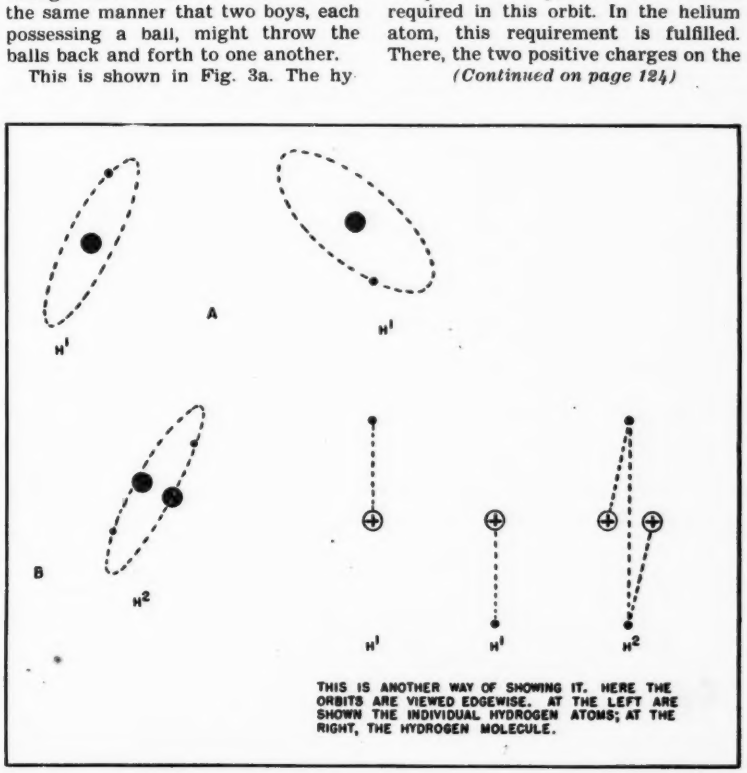

A
H¹
H¹
B
H²
H¹
H¹
H²
THIS IS ANOTHER WAY OF SHOWING IT. HERE THE ORBITS ARE VIEWED EDGEWISE. AT THE LEFT ARE SHOWN THE INDIVIDUAL HYDROGEN ATOMS; AT THE RIGHT, THE HYDROGEN MOLECULE.

Fig. 3. (a) The hydrogen atom consists of a single proton around which revolves a single electron. (b) Since the orbit surrounding the nucleus of a single hydrogen atom needs two electrons for complete satisfaction, two hydrogen atoms combine to form a molecule as shown in this diagram. Each electron partially satisfies the dissatisfaction of the other orbit

The PRACTICAL ENGINEER

DEVOTED TO PLANT OPERATION and MAINTENANCE

A. W. KRAMER, EDITOR

Magnetic Flux Has Bearing on Power Plant Operation

Our friend George is having his troubles again! This time his problem is to figure out why the main bearing of a cross-compound Corliss engine-generator set keeps burning out for no apparent reason. His experiences are interesting and full of practical tips

By GEORGE HOLMAN

ONCE UPON A TIME (time and a half for overtime) I are helper in machine shop where are repair all parts of power house which can be brought into it, or to which repair shoppers can be sent. Later on I are move up ladder of success to flunkey, 3rd class. But this here story are happen before I get importance enough to not wipe engine parts which can't be seen anyway. I are flunkey, 2nd class, which are of such lasser faire nature that he leave dust unwiped for week, and thereby furnish clue which help me solve problem of why a main bearing of the cross-compound Corliss engine-generator set kept burning out.

Howsomever, I are mechanically declined, and are good enough to hit chisel 7 times out of ten, and thumb or other hand parts only 3 times. This mean I are also good enough mechanic to clean ash flies out of breeching, help fireman dig big clinkers loose from grates with slice bar and climb pert neart rusted away U-rungs on 175-ft brick chimney to see are cracks in storm top any bigger after heavy dynamite shots in nearby rock quarry. I are also assigned to climb pothead pole during rain to see are any water going into conduits, or wire fixing for electrician that this maybeso to fix wire for electrician.

"I are good enough to hit chisel 7 times out of 10, and thumb only 3 times!"

It are while I are up this pole on wire fixing job for electrician that this here story actually begin. Pole have three or four dozens wire on it, mostly coming out of potheads. Engineer have tell me feeder switch to rock crusher are open. I do not dispute his word any. But I have great respect for electric wire, mainly because I are completely unable to tell by looks or otherwise whether she are just copper or aluminum, or have been fill by generator with nasty little things called electrons. Whenever I touch wire or busbar or switch loaded with electrons, they do anything from tickle my fingers to shake me till bones rattle. Are contact much prolong, or should electrons have lots of volts pushing them, this shaking by electrons business have serious consequences.

"Then There Are Big Flash"

To make sure no electrons are sneak up and down in 2400-volt line to rock crusher unbeknowingst to engineer, I carry up pole one long piece of heavy insulate wire with bare ends. I hook one bare end to guy cable below Johnny-ball, then swing wire till other end touch wire I are gonna work on. If pole wire have electrons in it, they jump at grounded wire like rattlesnake at stick teasing him, and with fire and fury. I have try this at other places where electrons have less volts. But never have I get so much as spark at pothead pole till this day. Then there are big flash which don't let me see much else for awhile. Wire ends burn off and insulation get hot and sticky in hand. This show that engineer have pull wrong feeder switch. Line I are to work on are loaded for bear with electrons.

Through engine room window I see electrician adjusting flux on compound engine generator. He are look up at flash. When I holler down that line are hot as six-ace flats in crap game, he run to pull right feeder switch. Then he hurry outside to see how come I are still in this world. When I show him my trick with insulated wire, he say: "Good Lord!" like Almighty are hard of hearing. "It's a good thing for you this is a dry day!" Then he come up pole to help me fix wire, which we finish just as quitting whistle blow.

Now, what are all this got to do with burned out engine bearing? Ho! Wait and see. Because electrician are forgetful, and go off on another job next day.

At 7:30 next morning engineer hurry into repair shop. "I've just burned out the main bearing on the high pressure side of the compound Corliss." he say to Boss-man. "I can't understand it. She was gittin' plenty oil. She started to heat fast when the crusher load hit. Before I could git another engine started to take part of the load, the babbitt was draggin' around the shaft. On the end next to the flywheel she melted and run out."

This engine are needed badly, so only two machinists shop have are put on job to replace burnt bearing with new one kept ready. I are do some other work in shop, then go to engine room for looksee. Machinists are 10 ton flywheel, 2 ton generator They have railroad jack in crankcase

Engineer complain. "She's gittin' hot!"

and under 6 in. crankpin. This hold up one end of 14 in. shaft on which a 10 ton flywheel, 2 ton generator rotor and 1 ton crank disk. Seeing as how crankpin are only press-fitted into hole in crank disk, I are disapprove of so much heaviness on it.

"Take Her Out! Something's Wrong"

New bearing run cool till half load are put on engine. Then engineer complain, "She's gittin' hot." Boss-man say, "She'll run warm till she wears in." "She might wear out first", engineer say, and cast look of dark suspicion on machinist's ability. When oil vapor from bearing turn blue and smell burnt, Boss-man say: "Shut her down. Somethin sure is wrong. We'll have to take her out and see."

Off come 1,000-lb bearing cap and are let down to floor by chain fall. Out come adjustment wedges. Out come first side quarter of 3-piece bearing. Out come second quarter. Crankcase oil are drain out. Into crankcase go railroad jack. Up come 15 tons of shaft, flywheel and parts attached, with nobody paying heed are rotor jamming against stator or not. Out come bottom half of bearing. All three parts show rub of shaft only in middle. When I pick up side quarter I are astonished when I feel end next to shaft collar for eccentrica are warmer. I think maybe I feel warmer with one hand than with other, and turn bearing half way around. But other hand feel same end warmer. This are puzzlement to me as well as jaybirds.

Boss-man feel rubbed place in middle. "Looks like you fellows never fitted a bearing in your lives," he snort. "Help 'em, George."

Out come babbitt scrapers. Out come can of Prussian blue. Up and down go bearing parts on fall hook, with me on chain loop which have no end. I get exercise like prizefighter. Machinists scrape and blue, blue and scrape. Boss-man smoke. By and by bearing parts rubbed on blued shaft get blue all over, whilst I get blue only in face. Shaft are let down on bottom half of bearing. Side quarters are set in. Wedges are place, cap put on. By time oil in crankcase are change, oil filters clean and engine ready to start, clock hands are come together at midnight.

On light night load engine run well. But when heavy load from rock crushers and dust mills hit at 7:00 a.m., bearing burn out again.

"Old Bearing Must Be Rebabbitt"

Are no new bearing, so old ones must be rebabbitt. Whilst machinists take off crossfeed and make wooden saddle on carriage of big engine lathe, I melt out rest of old babbitt with blowpipe. On other lathe I turn wooden mandrel smaller than engine shaft, wrap heavy paper around her and tie with string. While machinists are set up bearing for pouring right on lathe carriage where she are to be bored, I make mud to seal forms and mandrel by crumble up asbestos lagging in oil. Then I build fires on two forges and start babbitt to melting in ladles on them.

Boss-man say use old babbitt thereby to save money. I get other bearing set and melt out old babbitt. This do not cool quickly enough to pick up from iron plate, so pour water from temper tub on her. This are good procedure, are I only smart enough to stop there. But ladle can hold little more babbitt, and besides babbitt in her are getting pink, which everybody know is bad for her. A cold and wet piece of babbitt do double duty of cooling melted babbitt and filling ladle up. But when I drop wet piece in ladle, rest of babbitt don't like much company. It blow up into air, and come down like rain everywhere. I get burn on face. But Boss-man get hottest, cause he are hafta use 50 lbs more new babbitt.

Skim babbitt and stir it up and over, up and over, like direction book say. Machinists get up on boxes each one side of lathe. Me and Boss-man carry ladles and hand them up. Machinists quickly make pour.

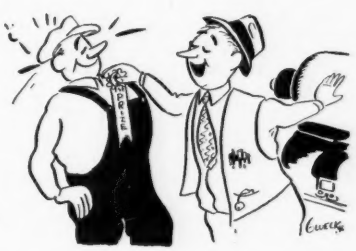
Babbitt like pour so well she open up form and pour out at bottom down into chip pan. Boss-man and machinists mouths open up and pour out words which I are unable to find in dictionary. I grab a handful of mud and try to stop up hole. Change mind when glove get so hot I are jerk it off.

We start over, mostly with new babbitt, and with new bearing forms tied up like old fashioned jaw with toothache. This time we get pretty good scald. Machinists knock mandrel out, set up boring bar in its place and proceed to bore out bearing to shaft size. I do not work this night. But in morning, I learn that Boss-man and machinists work all night. They watch bearing close, and twice take her out for scrape. After she get hot with crusher load, dead tired machinists give up trying to fix her. Thereby Boss-man twist face and say, "Guess we'll hafta let George do it!" Wherefore I have headache wished on me by wisecracker.

Now, I are not machinist with many years experience. But I are make plenty mistakes, which are pert neart same thing as experience. I go at bearing with idea of not getting any more same. I make sure babbitt fit all over. I polish out marks on wedges by grinding on lapping plate. I find rough ridges and grooves on side of shaft collar where it are rubbed on bearing end, and file them out, I see are shaft in line. I work all night, and by morning have engine running smooth. But when engineer put crusher load on her at 7:00 a.m., bearing warm up so fast he take load off quick and shut her down.

While engineer are concern with other duty, I try to figure this one out. Bearing are in A-No. 1 shape. Engine line up good. Wedges are adjust good. Bearing neither loose or tight. Oil grooves good and lots of oil. Shaft are smooth. Load are same. Engine are give no trouble for six year. Then sudden-like bearing get hot time after time, no matter how skillsomely made and put in.

It get more and more plain that this here are not job for skill, which I don't have much of, or for experience, which don't help machinists any, but for brains, which I ain't got hardly any of, either. It are getting cloudy-clear that something are happened to engine which cause bearing to burn out first time, and that is are something which nobody think of because she are hard to put finger on.



"By George! I oughta put you on this job in the first place!" he say. "You'll make a crack machinist one of these days!!"

"I Forgot to Set That Stator Back"

I look up engineer and ask are any work done on engine just before first burnout. He say no, except electrician make adjustment between stator and rotor. I then remember he are at it when I draw arc on pothead pole. This tell me nothing till I look generator over. When I see by unwiped dust that stator have lately been move over toward hot bearing. I make quick, personal call on electrician and ask will set over stator push shaft hard against bearing ends enough to cause heating. "Oh, my goodness, yes!" he say. "I forgot to set that stator back the other day. I'll set it back now. But don't tell the boss, or I'll lose my job."

While engineer are elsewhere we set stator back to dust line. When engineer come back I tell him I have

make further adjustment on bearing, so will he start engine and put on load. By time Boss-man make rounds, engine are pulling load, with bearing cool. He feel bearing, look at load on switchboard meters, and grin from here to yonder. "By George!" he say, taking my name in vainness. "I oughta put you on this job the first time. You'll make a crack machinist one of these days."

I are keep tater trap shut, which are thought to be modesty or maybe-so deep wisdom. But are flunkey, 2nd class, up to snuff with dust wiping from machinery, like he oughtn't to be, I are not so good bearing fixer as Boss-man think. Don't you?

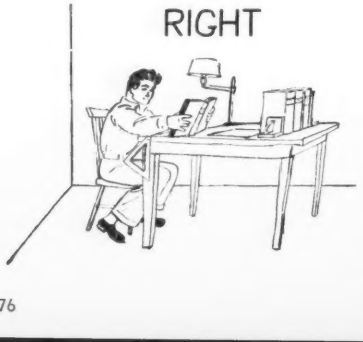
So—You Are Going to Take an Examination!

Part II—Preparing For The Examination. Before actually getting down to the "brass tacks" of studying for your examination it is wise to find out what subjects the examination will cover, and then plan a definite study program. A knowledge of the basic principles of mathematics should be a "must" item, regardless. Organize your information and plan definite study periods—and stay with them. Plant visitations and chats with the operating engineers may also provide valuable data. End your study program a week before the examination, and take this week for mental rest. Take the examination with your mind relaxed; not mentally fatigued

By CYRIL F. GREENE
Resident Engineer, Traveler's Insurance Company

THE TRAVELER who has no clear idea in regard to where he is going is not very likely to reach a desirable destination in a reasonable space of time. We must think of that fact as we begin the preparation for our examination. While our own particular engineering work may not be too difficult to learn about, we must remember that a relationship exists between the various branches of engineering; so we must be careful not to get off on a sidetrack while pursuing our studies.

If, for example, our goal is a higher license in steam engineering let us beware that our experience with power plant electrical equipment does not lead us too far along the path of electrical knowledge when we should be devoting the time to steam. In the same manner boiler feedwater analysis can lead us into chemistry and fuel burning into the field of combustion. There is much that we can learn from these things with profit to ourselves but let us follow the sound rule of putting first things first.



Stating the matter briefly we must find out just exactly what it is that we are supposed to know and then bend all our efforts to study and learn about those things. The most reliable source of this information is, of course, the examiner himself. I am sure that there are few examiners who would not willingly state in simple terms just what the examination will cover. If the examiner cannot be readily reached then his state or city department could be contacted for an outline of the requirements. When we attempt to obtain the requirements by asking those who may have passed the examination there is always the possibility that we may receive unintentional misinformation or an exaggerated statement of the requirements that may tend to discourage us before we start to study.

Having obtained a generally clear idea as to what the requirements are for our coming examination the next thing to find out is just where the necessary information is to be obtained. At this point we must agree that the men who live in or near the large cities have a decided edge as far as finding the source of learning is concerned. Under such circumstances there are usually specialized courses available in either day or night schools to give exactly the right degree of preparation for the desired examination. Also there are classes available in general subjects which act as a base on which to build the knowledge that we must have. To the men who have these advantages it is simply a case of finding the right place to obtain the needed help and information.

It is far different, however, for the man who lives and works in the small town far beyond the reach of the big city's advantages but who must nevertheless meet the same examination requirements since he lives in the same state. These are the men that I want to talk to now and for the sake of having a basis on which to begin our talk I am going to assume that they desire a license to operate a medium sized steam plant.

Learn the Principles of Mathematics

My first and most important word of advice would be to the effect that they should learn mathematics. Right now I can see how that word "mathematics" has really scared some of you to the point where you are ready to leave this article for something less discouraging. But wait! Let us not allow the word to frighten us since what we need along this line is considerably less than is used by even a beginner in astronomy. There is no doubt about it, a knowledge of the principles of math up to the required point will give us a feeling of confidence that is well worth having.

Now as to the required point that I just mentioned and where do we start to reach that point? We start, believe it or not, with the very simplest problems in addition, subtraction, multiplication and division. Just in case we are among those who believe that we are as good at these simple basic things as we ever were, let us try our hand at a few problems and I am sure that we shall soon learn that this review was much needed and that the whole idea is most helpful and getting more interesting as we go along.

Square Root and Transposition

Having satisfied ourselves that we can now do these basic problems let us proceed to square root. At this point you may need some assistance. The author has found in such cases that high school math teachers are a great help. Since your needs are simple it isn't going to burden them too much and they are glad to give you a lift. If you have to have help you might just as well get instructed about the transposing of formulas and that about completes this part of our work. Note that we have only taken two steps beyond the simplest functions of arithmetic, and yet, if we have done our work well we stand ready to solve almost any problem based on a state boiler code or the code of the American Society of Mechanical Engineers. Hard to believe, isn't it?

Having found out accurately just what we need to learn, and having built a solid, but simple foundation of mathematics on which to stand, let us now turn to the acquiring of the needed information with which to continue our journey.

It would seem to be wise at this time to list the things that we must learn about. Let us keep the list to as few main topics as possible, for example, "fire tube boilers," "water tube boilers," "pumps," "steam engines," and so forth. Next let us provide ourselves with a supply of good quality file folders and on the tab of each folder we will write the name of the topic for which information will be placed in the folder. For example, we will title one folder "Water Tube Boilers" and on the inside of the folder we will neatly list the names of the various types of water tube boilers.

The file folders should be kept in one of those cardboard letter file cases that look like a book. There is of course no limit to the amount that you can expand your files and still have any information that you need right at hand. You know of course, what goes into these files, but in case you would like to go over one of them, let us pick out the file which is tabbed "Water Tube Boilers." Of course, in order to get a good picture we must assume that you have been studying long enough to be about ready for examination.

We find the list of trade names and types on the inside cover of the folder. Inside the folder itself we find such helpful information as catalog cuts showing design features, drawings of the boilers that you have made showing general arrangement, baffling and gas travel, clippings from POWER GENERATION which carry information on this subject, notes and sketches that you have made while visiting other plants and a few pressure calculations that you have worked out. Do you think that it would be possible to spend an evening reviewing a file such as that without strengthening your position as far as knowing about water tube boilers is concerned? Don't you agree that it would be very satisfying to have that amount of information within reach at all times?

Technical Books Where to Find and How to Use Them

HAVING the files established the next thing to look for is books. The author cannot recommend any particular books since we are only discussing examinations in a general way. It is true that we are using a steam engineering examination as an example but the example is just as good if you have tabbed those files we were talking about "Wiring," "Overload Protection," Lightning Arresters," etc.

The natural place to look for books is the public library. The libraries in the smaller places do not usually have many technical books, but it is better to find this out for yourself than to just guess that this is so and thus overlook something good. One thing that all libraries do have, however, are librarians, and librarians are people who are trained to know about books. Your own librarian may not know the difference between buckstays and babbitt, but she does know who publishes books, the kind of books they publish, and just what address you should put on the envelope when you write to them.

Always remember that the most successful men in your line of business know about and probably own the best books. Talk about books with anyone whom you feel can help you to find the right ones for your study.

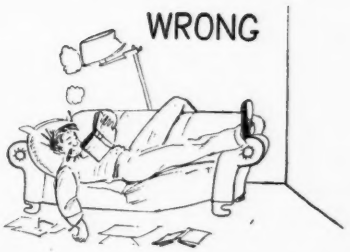
Before we leave this subject of books let us be sure that we know how to use them. Here is an experiment that you can try just to prove for yourself the proper method of using a book: Take your wife's favorite cookbook and pick out a cake receipe that tempts your appetite. Ask your wife to read the recipe. After she has finished reading it take the book away from her and have her make the cake. After the cake is baked give the book to her and let her try it again, this time going over the recipe one step at a time in her usual manner. Now compare the two cakes, or better still, take them both to the plant and ask the boys to guess which one *you* made!

Some books are written to entertain us and we enjoy them in moments of relaxation, but the kind that are written to help us pass examinations are written to be *studied*. You study a book by reading it slowly and carefully and by making sure that you understand each part as you go along. If you do get stuck don't get discouraged or make a mental wreck of yourself trying to figure it out since there is always someone that can give you a helpful word of explanation if you inquire for it.

Set Up a Study Program and Stay With It

Set yourself a good study program and try to stay with it. Pick the best time of year to study, since not much can be gained by working on a hot night when perspiration is dripping off your eyelids on to your work. Don't take too much time away from your family for your studies, since you need to enjoy the family as a means of relaxation. If the kids are noisy and that distracts you, try to find a quiet location for your studies. The family is rooting for you anyway and they will be much more on your side if you don't have to do any scolding while you are studying.

In the first article of this series I told about the man who felt that he was lacking in experience because he had not worked in many plants. In this section, I have mentioned the notes that should be in your files from visits to other plants. Visiting is a helpful form of examination preparation, but this too should be done with a good degree of planning.



Going to visit a plant without pencil and notebook is just expecting too much of your memory and is placing you in a position where you are not getting the most out of your visit.

Tell your host that you want to start your trip at the point where the fuel is stored and then proceed in an orderly and progressive way. List the objects along the line of flow and make sketches of interesting things. Maybe your sketches won't look like very much at the time, but you can fix them up for your file later on.

Relax a Week Before the Exam

End your study period one week before the examination. You will need this week for mental rest that will be most helpful. No doubt you felt that you were about ready when you sent the application to the examiner, so there is no reason to believe that much more good work could be accomplished at this time. If you are a baseball fan, you are no doubt aware that it is a wise manager who does not tell a pitcher that it is his turn to pitch tomorrow. To do so might create a condition where the pitcher would lie awake all night pitching the game mentally. Being thus fatigued by his all night mental exertion he would be lucky to last three innings. So the manager tells him on the day of the game.

Of course you know the date of the examination, so a surprise cannot be worked on you that way. Do realize, however, that there is nothing to be gained by thinking and fretting about the examination just before it takes place. On the other hand much of the good that you have gained by careful study might be lost to you because you may get yourself mentally tired.

If you do find the last few days before examination to be a bit nerve racking, then remember that there is no possible way of your knowing just what the questions will be, so why worry about the unknown. On the other hand you can remind yourself of something that is known, namely, that you have done your best to find out the scope of this examination and have carefully prepared yourself for it.

PRACTICAL ENGINEER SECTION

Thread Cutting in the Lathe

Part III. Final considerations . . . Cutting Acme threads . . . Threading tools for cutting square threads . . . Whitworth threads . . . Formula for cutting metric screw threads . . . Cutting multiple threads . . . Electrical coil winding on the lathe

By CARL THOMAS

IN THE FIRST and second parts of this series, there was described the various types of threads and the exact procedure involved in thread cutting. Now, consideration will be given to the cutting of some special threads, such as the Acme, the square thread, Whitworth threads and standard pipe threads.

In cutting Acme threads the tool should be shaped as shown in Fig 19 at (a) and (b). The formula for Acme threads is given at (c) in this figure. During the threading process it is important to check the forms with an Acme thread gage to insure accuracy. Acme threads are cut similarly to American National threads except that the compound rest is set at 14½ deg instead of 29 deg, and lighter cuts should be taken because the total cutting face of the tool is longer.

Figure 20 shows the shape of threading tools for cutting square thread, and also gives the formula for this thread. When cutting this thread with a large lead the tool angles must be absolutely correct. As shown in the figure, clearance should be allowed on both sides of the cutting point, tapering from both the top square threads to the minor diameter and the front of the tool.

It is advisable to cut external plus about 5 thousandths of an inch deeper, and internal square threads to the major diameter plus about 5 thousandths of an inch deeper. This will give a small clearance at the bottom of the thread to help compensate for any small inaccuracies in the tool or cutting.

Set the compound rest at zero degrees when cutting square threads and take very light cuts. The feeding of the tool with the compound rest and backing out with the cross feed are the same as for 60 deg Vee-type threads. The cutter bit or threading tool are set square with the work in the same manner as when cutting Vee-type threads.

The cutting edge of an external thread tool for square thread should be exactly as wide as one half the thread pitch. But for internal square threading the cutting edge of the tool should be made from one to three thousandths of an inch wider so as to insure a free fit on the screw.

The formula for Whitworth thread is given in Fig. 21. This thread is standard in the British Isles for nearly all types of threads. Smaller sizes of Whitworth thread are called British Standard Fine.

Whitworth threads are cut in a similar manner to Acme thread. However, the thread angle is different, and the radius at the top and bottom of the thread must be shaped properly with a tool ground to this form.

Pipe threads, Fig. 22, may be cut with a 60 deg Vee-type tool. The straight type threads are cut in the same manner as bolt threads. The tapered form of this thread can be cut with the same type of tool by setting over the tailstock, to obtain a taper of approximately ¾ in. per foot, as for taper turning. However, where the stock cannot be mounted between centers, the use of a taper cutting attachment is necessary. It is recommended that a special pipe center be used for supporting the stock while cutting threads. These can be purchased, but the price for tailstock arbor and pipe centering cone to take pipe from ¼ to 4 in. in size is around $17.

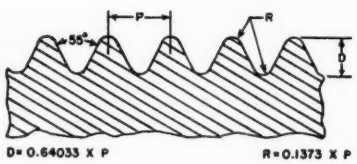


Fig. 21. Whitworth thread formula

When cutting right hand pipe threads the compound rest should be set at an angle of 29½ deg, pointing toward the lathe headstock.

Figure 8 (Part I) thread formula gives the formula for Metric Standard screw threads. Actually metric threads have a small radius at the root of the thread, that provides greater clearance, but for practical purposes this can be omitted since it requires a specially shaped cutting tool. The thread formula for American National threads can therefore be applied when cutting metric threads.

The regular change gears on some lathes can be used to cut the majority of metric threads. Other lathes require transposing gears for this purpose.

When cutting metric threads the exact same procedure should be followed as for American National threads except that the threading dial cannot be used because metric threads have no definite relation to the threading dial. For this reason it is necessary to follow this procedure: After the carriage feed has been engaged for the first cut, do not disengage it until the thread has been completed. As the tool reaches the end of each cut, back out the cross feed and stop the lathe. Then reverse the motor until the tool has been returned to the starting position. Advance the cross feed then to its original zero position, advance the compound rest for the next cut, start the motor and repeat the cutting operation.

The method of cutting metric threads also applies to special fractional threads and wire feeds.

Figure 23 gives the formula for a 29 deg worm.

Multiple threads may be cut by a process known as slipping teeth on the spindle gear. When this method is followed, the first groove is com-

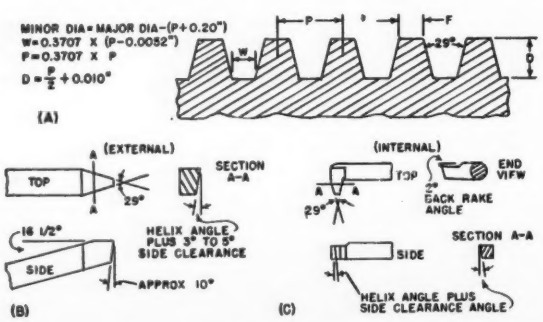


Fig. 19. Tools for cutting Acme threads

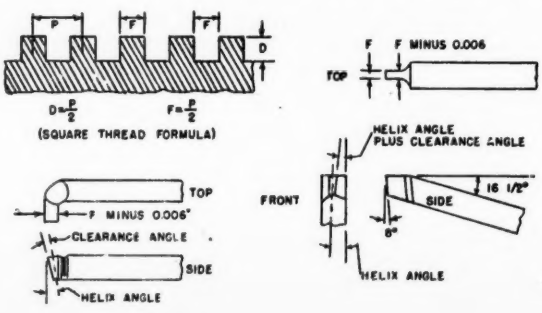


Fig. 20. Square threading too

pleted to the minor diameter, in the case of an external thread, and the major diameter in the case of an internal thread. Remembering to use the same zero point of reference on the cross feed for cutting each groove, disengage the change gear train and rotate the lathe spindle the proper number of teeth for the spacing of the next thread groove. Reengage the change gear train and complete the second groove. Follow this procedure until all grooves are completed. It must be remembered in cutting any multiple threads that the change gear set-up must be accord-

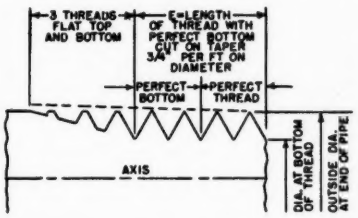

3 THREADS FLAT TOP AND BOTTOM
E=LENGTH OF THREAD WITH PERFECT BOTTOM CUT ON TAPER 3/4" PER FT ON DIAMETER
PERFECT BOTTOM
PERFECT THREAD
AXIS
DIA. AT BOTTOM OF THREAD
OUTSIDE DIA. AT END OF PIPE

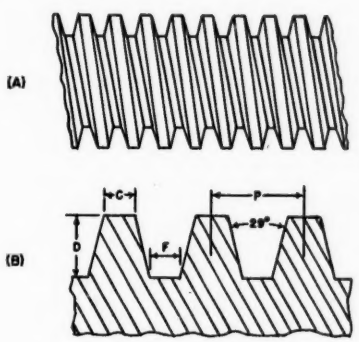
Fig. 22. American standard pipe thread formula

ing to the desired lead, not pitch, of the threads. Thus for cutting a double thread with a pitch of 24 threads to the inch the gear set-up must be for 12 threads per inch, or ½ the pitch. For a triple thread it must be ⅓; a quadriple thread, ¼, etc.

The threading dial may be used for cutting multiple threads but the procedure depends on the type dial being used. Since not all multiple threads can be cut with the aid of the threading dial, it is advisable to consult the instruction book for your particular lathe to determine whether the multiple thread you wish to cut can be cut with the threading dial or not.

Some lathe manufacturers can furnish electrical coil winding guides that mount in place of the tool post on the compound rest. This provides a convenient method of accurately winding coils. Feeds are available for winding B and S gage magnet wire in any size from 12 to 40, using bare wire or single cotton, double cotton, single silk, double silk, enamel, silk enamel or cotton enamel insulated wire. Feeds for winding springs, wire wrapping and coil winding with steel and iron wire in American Steel and Wire Company, music wire, American or B and S and Washburn and Moen gages are also available. The American or B and S gages apply to copper, brass, bronze, aluminum and other nonferrous wires.

The majority of these wire sizes can be wound with the standard change gears on some lathes. Gears for providing proper feeds for sizes not accommodated by the standard gears can be obtained from the factory.



THREAD FORMULA

P (PITCH) = 1 / NUMBER OF THREADS PER INCH

D (DEPTH) = .6866 P

F (FLAT) = .31 P

C (FLAT) = .335 P

Fig. 23. 29 deg worm thread. (Brown & Sharpe)

PRACTICAL ENGINEER SECTION

In mastering the elementary details of thread cutting, practice will be found to be the best means. Use scrap material until you gain sufficient experience to warrant your attempting thread cutting on finished work. Take your time and double check every detail, for a single mistake may spoil hours of work. But don't let mistakes discourage you. Threading is not easy, but it can be learned if you study and practice. The ability to cut external and internal single and multiple threads in any of the numerous sizes will give you a confidence equal to that of any other skill you can master in lathe work.

LETTERS AND COMMENTS

ARE YOU GETTING THE MOST OUT OF YOUR Q. & A. SECTION

WITH REGARD to the use of a question or data sheet as suggested on page 71, March issue, I would say no. I have filled out numerous questionnaires on miscellaneous subjects, and in every instance I have found questions that were ambiguous, or that could not be answered directly. I very much prefer to be allowed to describe a situation in my own words.

The ideas expressed in your query are very good, but I would like to express them in my way.

1. Describe your plant completely, or if that is not necessary, then describe the part to which your problem applies. Do not be afraid of writing too much. You know, but we do not, and we can sift out the parts that do not apply.

2. Tell us if the equipment is in continuous operation, as in a power plant, or if its operation is intermittent or seasonal.

3. Does the management co-operate with the engineer in making changes or improvements? Or does it hold the engineer responsible for keeping the plant running and then leave it up to the engineer to use his own ingenuity in using such material as he may find available?

4. Is the engineer a man who started with a scoop shovel, or was he a skilled machinist before he started operating? What are his educational qualifications?

5. Is the engineer in complete charge or is he subordinate to a higher up engineering official, Master Mechanic, Factory Engineer, etc.? Does the company call in outside engineering advice at intervals, such as consulting engineers, or engineers from machinery firms?

In summing up the data submitted, the final answer frequently boils down to how much money should be put into the changes or improvements under discussion.

Los Angeles, Calif. H. T. LIVINGSTON

AIR GAP OF MOTORS

By W. E. Warner

MAINTENANCE of the correct air gap is important with all types of motors both from the standpoint of efficiency and the possibility of the rotor or armature coming in contact with the stator or field magnets. Bearing wear is the principal cause of unequal air gaps. Ball bearings have a great advantage in this respect as very little wear occurs.

If the air gaps are unequal the magnetic flux passing through the armature or rotor is unequal. The result is that the load carried by the coils, at different places around the circumference, is unequal. This may lead to momentary overloading of some coils, leading to sparking at the brushes and possible damage to the coils.

In the case of a motor, the unequal current distribution may result in the falling off of the load which can be carried and possibly an increase in current consumption.

Checking up on the air gap, when the motor is stationary, with a feeler gage is not reliable as the same air gap is not maintained while the motor is running. A good idea of the existing air gap can be obtained by having a man shine a light through the air gap while the motor is running while another man looks through on the other side.

Air gap readings taken while the motor is stationary are not reliable because if there is bearing play the armature or rotor, under the influence

of magnetic flux, will rotate to a greater or less eccentric. This may permit the rotor to foul the stator when the motor is running even if the air gaps seem satisfactory when the motor is stationary. This whirling of armatures or rotors in bow form is often the cause of fouling.

PREVENTIVE MAINTENANCE AND PERSONNEL EDUCATION

TO REDUCE outages of plant equipment to a minimum, most plant engineers are now working on a program of periodic inspection and scheduling of hours of operation.

This is really preventive maintenance and is followed with a fixed schedule. A report is also made, stating the condition of the equipment, and whether or not any repairs or replacements are necessary. In conjunction with the inspection of equipment, a program of cleanliness is followed out. Clean equipment gives better service and requires less maintenance.

Plant personnel education is another program which is receiving a great deal of attention today. It has been proved that when the plant engineer understands the "How, Why and Don'ts" of a piece of equipment, maintenance and outages are reduced. On each piece of equipment, or as close to it as possible, is placed a card containing instructions regarding the starting and stopping procedure.

The education, inspection, cleanliness, and instruction card system are all great aids toward plant safety campaigns, and the frequency of disasterous accidents has decreased tremendously.

Irvington, N. J. CHAS. H. ELBERT

Questions And Answers

Question No. 414

WHAT'S A PRACTICAL WAY TO ELIMINATE SAWDUST CINDERS?

CAN ANYONE tell me a practical method of preventing sawdust cinders from escaping from the stack? Sawdust is the cheapest fuel here, but the occasional passing of cinders from the stack is a perpetual problem to the neighbors. Spark arrestors are no good unless they are kept clean.

Wadsworth, Ohio L.S.M.

Answer No. 396

ELECTROLYTIC ACTION IN THIS BOILER?

THIS QUESTION is interesting in that it brings up a topic for panel discussion that has in past years probably been grossly over-rated. It is doubtful that corrosion in the case cited is due to electric action. It is probably a matter of dissolved oxygen and an acid condition. Metal deterioration by electrolysis undoubtedly exists in any boiler to an extent, however in view of modern materials and construction methods the severity of such action is hardly cause for worry. Many corrosion cases in the past have been erronously attributed to this type of metal deterioration while actually the true cause stemmed from oxygen and acid.

In order to intelligently estimate the possibility of objectionable corrosion from this source one should carefully consider the factors necessary for action to take place and the conditions influencing rapidity of attack. In order for corrosion to occur in this manner we must have two metals of different potentials. When two such metals are bonded externally and placed in the presence of an electrolyte, an ion exchange takes place. Anodic ions, or ions of the lower potential, tend to plate out on the cathodic surface; resulting in a gradual metal wastage of the anodic surface. It is quite evident that potential differences exist to an extent in any boiler since drums, headers, tubes, caps, etc., are never of identical materials. The necessity of stressing tube ends when rolling also brings about a change in potential. Anodic and cathodic areas also exist in a single metal section. It is probable that actual deterioration in a modern unit from potential differences existing is, at worst, a very slow process.

Bear in mind that metals, while in a state of deterioration from electrolytic action, have the ability to establish equilibrium of potential, in which case deterioration ceases. An acid electrolyte definitely increases the rapidity of attack. Severity is also influenced by boiler water density.

A case was recently brought to the writers attention where rapid corrosion was definitely attributed to electric action. The case involved a large iron body, bronze mounted, gate valve employed for blow down service, the material being a dense pulp. The high velocity passage of the relatively heavy material set up an action that damaged the valve at an alarming rate. The condition was rectified by substitution of a sphere type quick opening valve in which surface contact of sphere and seat does not exist.

In past years zinc plates have often been used to combat so called electrolysis corrosion in boilers. The theory being that the low potential of this material would serve as the anode. In modern practice however, this is usually considered an almost useless substitute for proper water conditioning. The advisability of this practice has been somewhat enhanced by the fact that plates are usually badly corroded when the boiler is opened for inspection. However deterioration in most cases is probably due to alkali attack, as zinc will disintegrate rapidly at conventional boiler alkalinities. It is interesting to note that prior to the war zinc plates were discontinued in the boilers of the S/S Majestic without resultant corrosion and at a direct saving of $500 per month.

The only real service performed by zinc plates in the writer's experience has been to lessen attack in marine condenser water boxes. The conditions of density and turbulence have often caused rapid corrosion of this type condenser, yet the real ability of zinc as a protector in such cases is actually questionable as many condensers have operated quite successfully without them. Cementing of water boxes is undoubtedly better practice.

Baltimore, Md. MARVIN PERSINGER

Answer No. 405

WHAT'S THE BEST AIRCRAFT NIGHT WARNING FOR A STACK?

AT THE TOP of the stack, and possibly down its sides at intervals depending upon its height, install U.S. Navy Standard Aircraft Warning Lights, symbol No. PLAN 9-S-5381-L, obtainable from Westinghouse Electrical Supply Co. The estimated cost of each light is $12.00.

These lights are 8 inches high, 5 inches in diameter, have a red globe, are watertight, and contain six 15-watt candelabra screw base lamps each, 115-volts. Because of the number of lamps in each light, relamping is infrequent.

I suggest two separate circuits, feeding two groups of lights. This will further lengthen the time between relamping.

Boston Naval Shipyard

WILLIAM E. BRUMDY

PRACTICAL ENGINEER SECTION

How to Recondition a Zeolite Softener

The answers to Question No. 408 were so numerous and well prepared that we believe they are worthy of publication as a separate article. C.J.R. should have no trouble cleaning out his softener and re-lay beds after reading all of these practical tips

Question No. 408

HOW SHOULD HE CLEAN OUT SOFTENERS AND RE-LAY BEDS?

I have two 8ft by 8ft down-flow Zeolite softeners that will soon need to be emptied, scaled, and painted on the inside, and the beds re-laid. The units contain approximately 339 cu ft of standard green sand. The manhole is in the top head.

I would appreciate comments and suggestions from those who have had experience with this type of job, particularly on the best method of removal and as to the best paint to use for protection against corrosion.

Junction City, Kan. C. J. R.

THE FIRST requirement for removal and replacement of the sand and gravel from a zeolite softener, is the same as for any other job, and that is be well prepared to do the work. The proper equipment and preparations beforehand can save much work and time. First, ample room is necessary to store the sand and the various sizes of gravel as they are taken from the tank. Second, several sizes of sieves are needed to sift the sand and gravel. These will be, a fine one for the sand, about 1/16 in. mesh; one of each, ¼, ½, ¾, 1, 1¼ or 1½ in. These sieves are constructed to suit the conditions at hand. Third, some sort of efficient rig is needed to remove and replace the sand and gravel.

The first simply consists of a good clean floor space to lay the gravel, but the sizes given above are general. The third is the most important because much time and work can be saved with the proper rig.

The best method for taking out the sand and gravel is to erect a chute from the manhole down to the floor. The sand and gravel is shoveled into buckets or cans and carried up a ladder to the manhole and dumped into the chute. It is caught at the bottom and placed in the proper pile. Don't dump it alltogether, but keep it as near separate as possible in order to avoid unnecessary work. When all of the sand has been removed, a retaining screen is sometimes fixed between the sand and the gravel beds. This screen is bolted to lugs welded to the sides of the tank. Carefully remove the screen and lay it aside in a safe place. If no screen is used, carefully scoop up the sand when the gravel bed starts to show. When all of the sand that can possibly be removed without taking up some of the gravel, has been removed, take up the joining layers carefully and put them into a separate pile If this is done carefully, this will be all that has to be sifted (of the sand). After this take up the succeeding layers or beds of the various size gravel being careful at the joining point to avoid as much sifting as possible..It may seem that I have put a lot of stress on the sifting, but if you let the gravel get all mixed up and have to sift 10 or 15 tons, you will get what I mean. By doing as I have suggested, you will only have to sift about a hundreds pounds at each layer.

After all of the sand and gravel is out, examine the laterals for deterioration or leakage and replace any that may be found defective. Clean out all holes in the inlet and outlet pipes, or laterals as they are termed. Take the brine distributors apart and clean them out good.

Carefully scrape the tank to the bare metal. Sometimes sandblasting is resorted to. Any dark spots that may indicate signs of pitting are to be chipped out, welded up, and ground smooth.

Paint the tank with several coats of good water-proof paint and allow to dry. Some of these paints give off a strong odor, so adequate ventilation must be provided or gas masks used.

When all of the work has been done and everything is in readiness to replace the sand and gravel again, rig up a single rope block with a large

Who do you guys think you're kidding? What would a grizzly bear be doing in here?

iron hook on the end of the rope. Several large buckets or cans are provided; while one is hoisted up to be dumped, the others can be filled. The gravel is placed in the tank as it came out. When all of a certain size has been put in, level it off as near as possible by eye. Then measure its depth with an iron rod to make sure that the bed is perfectly level. Then proceed with the next size. After all the gravel has been put in, replace the retainer screen, (if any) and then proceed to replace the sand.

When the sand is first removed a composite sample should be taken and sent to the laboratory of the softener manufacturer for analysis. When sand has been subjected to operating conditions for a period of years, it sometimes becomes badly deteriorated and it is better to replace with new, than to put the old back again.

While the softener is out of service for this work, it affords a good opportunity to thoroughly inspect the central control valves and other auxiliaries and put them in first class condition.

Baltimore, Md. CHAS. W. PARKS

J.E.S. Recommends an Asphalt Base Paint for the Tank

WE HAVE a Permutit Zeolite softener which we cleaned recently. First scrape about an inch or two of Zeolite from the top of the tank with a hoe or rake and pull it to the manhole. Take it out with a pail and throw it away. As soon as you can make a hole big enough, have a man crawl inside to fill the pail. The rest of the Zeolite, as well as the stones, can be used over again.

Keep each grade of stone in a pile by itself. When you refill the tank, all that will be needed is some new Zeolite to replace that which was thrown away.

As for painting the interior of the tank, we have had good luck with asphalt base paint. Only use a flashlight in the tank when painting as the paint gives off a gas. If an electric light is used, the bulb may break and an explosion might occur.

Newark, N.J. JACK E. SENGEL.

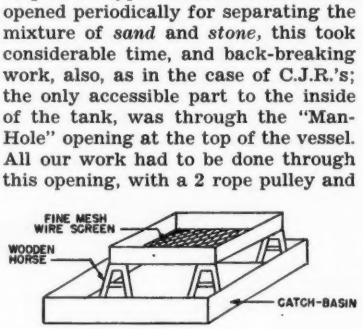
A.F.C. Gives His Method

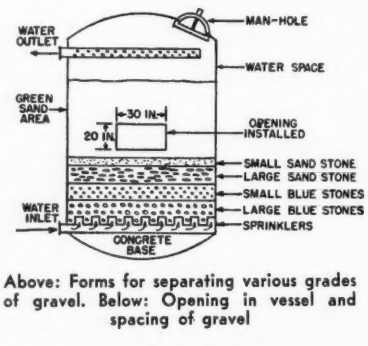
QUESTION NO. 408 is one I firmly believe C.J.R. should give immediate attention. I hope I can in a small way contribute some pointers as to the method in overhauling his water softener.

Through my past experience with two similar softeners, I have found that the "down-flow type" seldom needs overhauling, although occasionally, and only when necessary, more "green sand" must be added to the unit due to the fact that small quantities of this sand will occasionally work itself out during a process of recharging. Other than that, the beds or layers of sand and stone are seldom disturbed.

My acknowledgement of this comes through actual experience with two types, (1) Down-Flow and (2) Up-Flow. Our "down-flow" type, up to the day it was carted away by a scrap truck, never was touched other than to apply a few "wheelbarrels" of "green sand," which happened rarely.

On the other hand, our No. 2, or "top-flow" type of softner, had to be opened periodically for separating the mixture of *sand* and *stone*, this took considerable time, and back-breaking work, also, as in the case of C.J.R.'s; the only accessible part to the inside of the tank, was through the "Man-Hole" opening at the top of the vessel. All our work had to be done through this opening, with a 2 rope pulley and





Above: Forms for separating various grades of gravel. Below: Opening in vessel and spacing of gravel

pail; the only thing that would clear the meager amount of space a manhole will allow. It was not long before a new method had to be found to remove this matter. Our "Chief Engineer" at the time thought up the brilliant idea of cutting out a portion of the "tank shell siding," 20 by 30 in. sq. at about the base level of the "green sand" in the vessel, by means of an acetylene torch cutter. With that removed we were ready to proceed.

(1) A strong hoe was used to pull out the major portion of "green sand" on to the floor through this opening on the shell siding of the vessel. This opening also provided adequate room for a man to enter with a shovel, throwing out the remaining sand that had not yet mixed with the "small sand stones." While this was in progress, a group of men working around the outside of the vessel, were busily engaging themselves upon clearing the *sand* away in preparation for receiving the first portion of mixed matter, that being "sand" and "small sand stone," which was not long in coming.

(2) To separate one from the other, a box form 20 in. by 20 in. by 6 in. high, with a fine mesh wire screen at the base, just large enough openings for the *sand* and only *sand* to pass through, was constructed. This form was laid on top of two wooden horses, app. 30 in. high. With that set up, two shovel fulls of this first mixture was introduced into the form, and with the aid of a water hose, the *sand* would wash through into two makeshift catch-basins; later to be shoveled up and thrown on the clean sand pile. This left the "small sand stones" in the form to be later piled off in a separate pile. This worked well with very little sand being wasted down the water drain.

(3) The next mixture to contend with was that of the "small sand stone" and "large egg-shaped sandstone." The separation of these differs from that of the 2nd procedure. A rectangular box form was used measuring 8 ft by 6 ft by 8 in. deep, set up at app. a 45 deg angle from the floor and braced up at both sides with two boards to steady and keep in place. The mesh screen wire in the base was more durable and the openings were large enough to permit the "small sandstone" to pass through. The reason for setting up this form at this angle was to delay the rolling action of this mixture being thrown up against it. This enabled the small stone to find its way through the screen, separating it from the larger stone. With that completed, carried off to the side, and piled separately, they were washed down of dirt, mud and particles of sand, that still adhered to their bodies.

(4) Following that, we confront ourselves with the mixture of "large sand stones," and "small blue stones." Using the same cross-section measurement of the last form, with the exception of the base, which calls for a wire mesh large enough to pass the "large sand stones" through, we then proceed as we did in step No. 3, separating, piling, and washing down the dirt, mud, and particles of sand that still adhered to their bodies.

(5) We proceed by removing the "small blue stones" in which will be found not many, but a few of the "large blue stones." They are removed by hand and piled in their respective places; also washed down as before.

(6) The "large blue stones" follow; that being also mixed slightly with the "small blue stones" and separated as in step No. 5.

This completes the cleaning of all matter in the softener. We prepare

PRACTICAL ENGINEER SECTION

ourselves, with the aid of the water hose, to wash out the entire internal surface of the vessel. All that shall be found, is soft mud, except that above the matter line, in the water space of the vessel, a harder form of scale may be found. Other than to wash or pull off the loose scale, the remainder is not disturbed. This, I might explain to C.J.R., is the best protective coating he could obtain for the interior of his "water softner tanks." In the event that his softener tanks are not corroded to that extent, that will warrant considerable repairs. Should that prevail, my advice would be to purchase new ones and save himself many headaches. I might also explain that scraping the surface clean and applying a protective coating to the shell surface will slightly effect the generating qualities of his softener through the chemical reaction of the paint. Also, the generating effects of the brine, during a charge, would eventually eat up the paint. So it would be wise, if conditions permit, for C.J.R. to leave the internal surfaces just as they are.

With our cleaning job completed, time is taken to check the concrete base of the vessel. Also checked are the sprinklers imbedded there to see whether they have been distorted or need replacing. The discharge pipe is also checked, to make sure all openings are cleared. This all done to our satisfaction, the vessel is ready for refilling.

The opening made in the tank sheet once again cuts down time and back-breaking work. We are able to lay each bed of *stone* through this opening with the exception of "green sand" that must be injected through the man-hole on top.

With all the *stone beds* evenly and correctly laid out, the newly made, rectangular cover is placed and bolted down to the opening made on the shell siding, for removal at any time in the future.

To inject the sand through the man-hole opening at the top of the vessel an old coal conveyor was used. One man held a pyramid-shaped funnel measuring 24 in. by 24 in. at the top and tapering down to 8 in. by 8 in. The conveyor was started and fed from the floor. His job was to keep moving this funnel around and around, equalizing the distribution of "green sand" throughout the vessel. Occasionally feeding would stop, and the inlet water valve on the softener would be opened to allow the sand to pack more securely. A repetition of the same would prevail, until the desired level of "green sand" was reached. With that obtained, work flushed the tank upward and down-ceased while the man-hole cover was secured to the tank. The operator ward a few times then charged the tank with brine. With that completed, the tank was ready for service.

Passaic, N. J. A. F. CUTTITTA

Not an Easy Job, Says J.F.S.

CLEANING OUT softeners is not an easy job. Two years ago we cleaned our softeners and painted up the inside of the tanks, a job that we do about every 3 years. The procedure we followed, although not an easy one, nevertheless was satisfactory.

Before we started we had collected a number of burlap bags. After opening up the tank we had to use a pail and shovel the Zeolite into the pail and empty it into the burlap bags. This was done until we reached the medium sand or gravel. The gravel was removed in the same way and placed into barrels, after which the coarse gravel was also placed into the barrels. The gravel was taken outdoors, screened and washed with a water hose under pressure of about 80 psi.

The softener tanks were then wiped out clean. The spray nozzles were removed and cleaned and put back. After scaling the sides and top of the tank, we used an asphaltum base paint for coverage. The job required 3 men working 9 hr per day for two days, or 54 man hours to do the work.

After cleaning and screening the sand and gravel, we then laid down the coarse gravel on the bottom of the tank, the medium sand over the coarse, and placed the Zeolite over the medium sand. After closing the tanks we rewashed and recharged the system the same as when in normal operation.

The paint that we used was called Bitumastic solution and was very quick drying. When using this type of paint we use a fan for circulating air into the tank as some of the men find its odors very obnoxious.

Rochelle Park, N.J. JOHN F. SLAVINSKY.

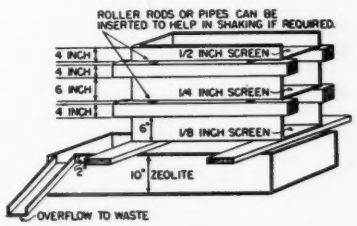
C.B. Offers Simple Jig For Separating Zeolite

USUALLY THE QUICKEST way to unload a softener is with a bucket. During the unloading process separate the various grades of gravel as much as possible. Then screen each material with a device similar to that shown in the sketch below. The coarse, or 1 in. to ½ in. gravel, remains on the ½ in. screen; medium, or ½ to ¼ in. gravel, remains on the ¼ in. screen; fine, or ¼ to ⅛ in. gravel, remains on the ⅛ in. screen; the Zeolite passes through all screens.

In the event that some Zeolite adheres to gravel, it will be necessary to wash the Zeolite through the respective screens with a stream of water. When the softener is emptied, care should be taken to inspect the strainer system thoroughly. This should include opening the backwash inlet valve, observing whether all openings are clear, checking the double elbow connection on the shell and strainer header, and cleaning or flushing out any material which may have collected in the laterals.

When reloading the softener, the strainer piping should be carefully

PRACTICAL ENGINEER SECTION



Details of jig for separating gravel

inspected and kept in its proper place. Then first place the coarse gravel in the bottom of the tank and level it. Next place the medium gravel on top of the coarse gravel, also leveling this off. Then place the finest gravel on top of it, level off, and then load the Zeolite on top of it. A word of caution: Any missing Zeolite, lost through too high a rate of backwash when regenerating the softener, should be replenished.

Astoria, L.I., N.Y. CARL BACHMANN

W.J.H. Tells His Method

SOME TIME AGO we installed two Zeolite Softeners to condition a very clear well-water of 9 grains hardness. Six weeks after operation, the water began to pick up a dark shade. We tried longer rinsing periods but to no avail. Opening the softeners we took out some Zeolite, and after running a series of tests, proved the Zeolite was at fault.

We called the makers of the Zeolite for advice. They replied that some time previously they had made some changes in their plant and we had been shipped, by mistake, the wrong kind of Zeolite. They would send on the right kind in a few hours.

Not wanting to go back using hard water, which would have necessitated making changes in our washroom formulas, we decided to change the Zeolite right away.

We built a platform against and on a level with the top of the softeners. One man, acting as a pivot, lowered a rope with a pail on the end through the manhole. The man inside filled the pail with one scooping motion. The pivot man pulled the pail up and swung it down outside to a man waiting with a wheel-barrow.

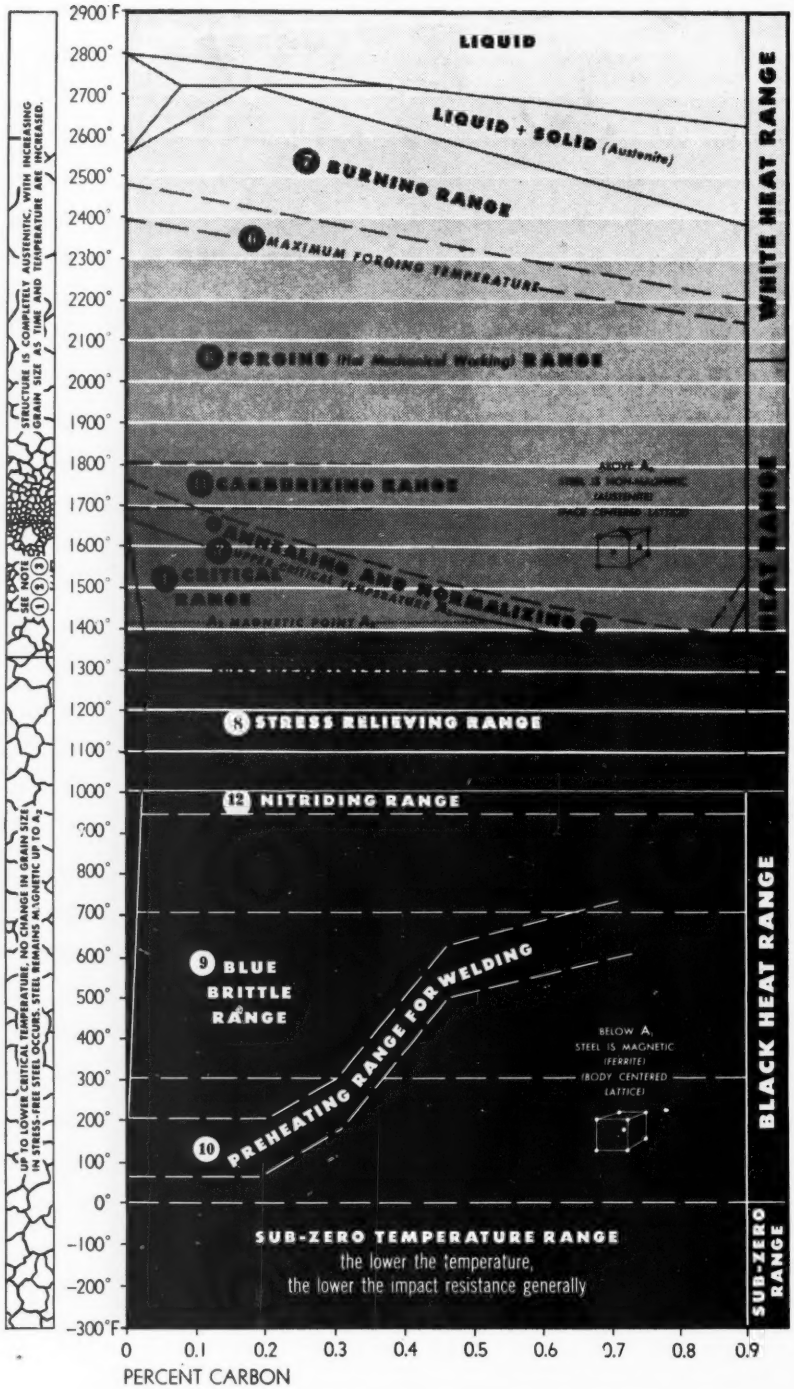
In a little over an hour we took 1600 lb of Zeolite out of each softener. We also took out about 3 in. of gravel and washed it with a pressure hose over an open barrel covered with Mosquito wire.

The softeners were back on the line in 6 hours. Incidentally, we had a well-protected, insulated light inside the tanks.

I have never seen any painting on the inside of softeners I've looked into. They are not very subject to corrosion.

Morristown, N. J. W. J. H.

Basic Guide to Ferrous Metallurgy



1 CRITICAL RANGE. In this range steels undergo internal molecular changes which radically affect the properties of the material.

2 LOWER CRITICAL TEMPERATURE (A_1). Termed Ac_1 on heating, Ar_1 on cooling. Below Ac_1 structure ordinarily consists of FERRITE and PEARLITE (See 14 and 17 below). On heating through Ac_1, the solid FERRITE and the solid PEARLITE begin to dissolve in each other to form AUSTENITE (see 15 below) which is non-magnetic. This dissolving action continues on heating thru the CRITICAL RANGE until the solid solution is complete at the upper critical temperature.

3 UPPER CRITICAL TEMPERATURE (A_3). Termed Ac_3 on heating, Ar_3 on cooling. Above this temperature the structure consists of AUSTENITE which coarsens with increasing time and temperature. Upper critical temperature is lowered as carbon increases to 0.85% (eutectoid point).

4 ANNEALING consists of heating steels to slightly above Ac_3, holding for AUSTENITE to form, then *slowly* cooling in order to produce small grain size, softness, good ductility and other properties. On cooling slowly the AUSTENITE transforms to FERRITE and PEARLITE.

5 NORMALIZING is similar to annealing except that cooling is done *in still air*. On cooling, AUSTENITE transforms giving somewhat higher strength and hardness and slightly less ductility than in annealing.

6 FORGING RANGE extends to several hundred degrees above the UPPER CRITICAL TEMPERATURE.

7 BURNING RANGE is above the FORGING RANGE. BURNED steel *cannot be cured* except by remelting.

8 STRESS RELIEVING consists of heating to a range definitely below the LOWER CRITICAL TEMPERATURE, holding for one hour or more per inch of thickness, then slowly cooling. Purpose is to allow the steel to relieve itself of locked-up stresses.

9 BLUE BRITTLE RANGE occurs approximately at 300° to 700°F., in which range steels are more brittle than above or below this range. Peening or working of steel should not be done in this range.

10 PREHEATING FOR WELDING is carried out to prevent crack formation. See TEMPIL® PREHEATING CHART for recommended temperatures for various steels and non-ferrous metals.

11 CARBURIZING consists of dissolving carbon into surface of steel by heating to above critical range in presence of carburizing compounds.

12 NITRIDING consists of heating certain *special steels* to about 1000°F. for long periods in the presence of ammonia gas. Nitrogen is absorbed into the surface to produce extremely hard "skins."

13 SPHEROIDIZING consists of heating to just below the critical range to put the CEMENTITE constituent of PEARLITE in globular form. This produces softness and in many cases good machinability.

14 FERRITE is practically pure iron (in plain carbon steels) existing below the lower critical temperature. It is magnetic and has very slight solid solubility for carbon.

15 AUSTENITE is the non-magnetic form of iron and has the power to dissolve carbon and alloying elements.

16 CEMENTITE or **IRON CARBIDE** is a chemical compound of iron and carbon, Fe_3C.

17 PEARLITE is a mechanical mixture of FERRITE and CEMENTITE.

18 EUTECTOID STEEL contains approximately 0.85% carbon.

19 MARTENSITE is an extremely hard constituent of steels, formed by the rapid transformation of AUSTENITE.

20 FLAKING occurs in many alloy steels and is a defect characterized by localized micro-cracking and "flake-like" fracturing. It is usually attributed to hydrogen bursts. Cure consists of cycle cooling to at least 600° F. before air-cooling.

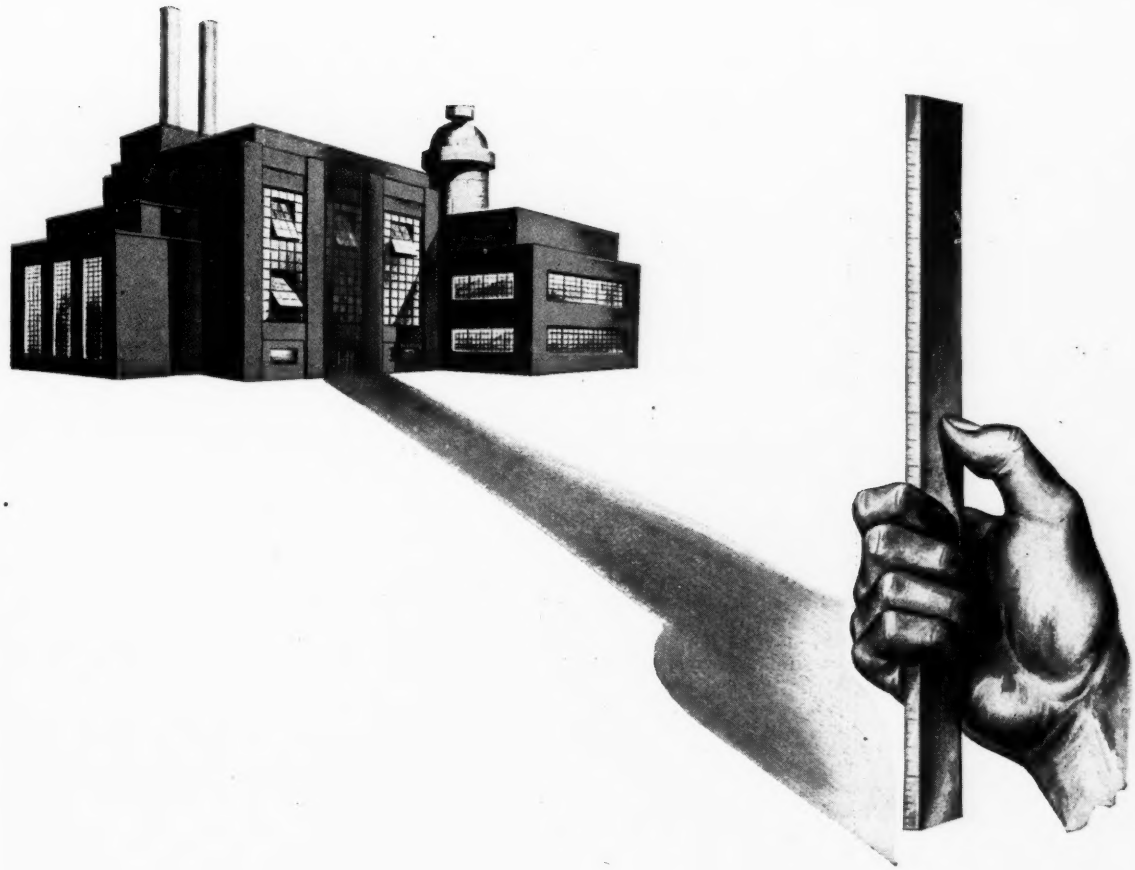
21 OPEN OR RIMMING STEEL is not completely deoxidized and the ingot solidifies with blowholes.

22 KILLED STEEL has been deoxidized at least sufficiently to solidify without appreciable gas evolution.

23 A SIMPLE RULE: Brinell Hardness divided by two, times 1000, equals approximate Tensile Strength in pounds per square inch. *(200 Brinell ÷ 2 x 1000 = appox. 100,000 Tensile Strength, p.s.i.)*

Chart, Courtesy, Tempil Corp.

This chart shows the working characteristics of steels at temperatures from minus 300 F to 2900 F. All the important temperature zones, including Hot-Working, Annealing, Normalizing, Stress Relieving, Carburizing and Preheating for welding are clearly defined. Twenty-three metallurgical terms are defined and explained at the right of the chart; a diagram symbolizing the change in grain size is shown at the left. This chart, in 19 colors and measuring 16¼ by 21 inches, is available to power engineers, plant engineers, and executives who request it on company stationery, stating their position. Address Editor, Power Generation, 53 W. Jackson Blvd., Chicago 4, Illinois.



How Well Does *Your* Boiler Plant Measure Up?

The effectiveness of your water conditioning can well be the yardstick of your boiler plant operation. How much *or how little* boiler water trouble you have is a true measure of successful, economical boiler plant operation. Consider then, "How well does *your* boiler plant measure up?"

Trouble-free operation is a result of scientific control.

W. H. & L. D. BETZ is an organization of engineers and chemists specializing in the solution of all industrial water problems. Years of experience have made Betz water conditioning service scientifically correct . . . complete . . . economical.

Our nationwide staff of engineers will welcome the opportunity of discussing with you this important subject of water conditioning . . . W. H. & L. D. BETZ, Gillingham and Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories, Limited, Montreal 1.

BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

Control of Barnacle Growth in Condenser Intake Pits

Three different methods of barnacle control were tried at the St. Petersburg plant of the Florida Power Corporation. The method which gave the best and cheapest results was the one using copper sulphate. This was finally adopted

By R. B. LEE, Test Engineer
Florida Power Corporation, St. Petersburg, Florida

WE HAVE had considerable trouble and expense due to the growth of barnacles in our condenser cooling water system which uses salt water. To reduce this trouble several methods have been tried for controlling them.

Our plant is located at St. Petersburg, Florida, and uses cooling water from Tampa Bay. The intake canal is concrete. There are four intake pits to condensers, all concrete. Traveling screens are located at the inlet of these pits. The vertical circulating pumps for the 25,000 kw turbine are located outside with shutoff valves. Referring to the accompanying drawing, it will be noted that it is possible to isolate one pit without shutting down either side of the condenser. With water at 85F, one pump will supply sufficient water to generate 30,000 kwh at a small loss in vacuum.

Three methods have been tried: (1) application of chloride of lime with approximately 30 per cent available chlorine, (2) increasing temperature of water, and (3) application of copper sulphate. The methods and results are covered below.

1. APPLICATION OF CHLORIDE OF LIME.

One intake pit was closed off by closing the valve at the circulating pump and putting stop logs in the inlet and center connecting openings. The volume of water in this pit is approximately 15 ft deep by 7 ft wide by 22 ft long or 2310 cu ft. This gives a weight of water of 144,330 lb. An application of 50 lb of chloride of lime was made and allowed to stand two hours. This water was flushed through the condenser.

Assuming that 50 per cent of the available chlorine was absorbed in the water, a theoretical chlorine residual of 62 ppm resulted.

An inspection of the screens on the following day indicated very poor results with this treatment. The barnacles were not killed.

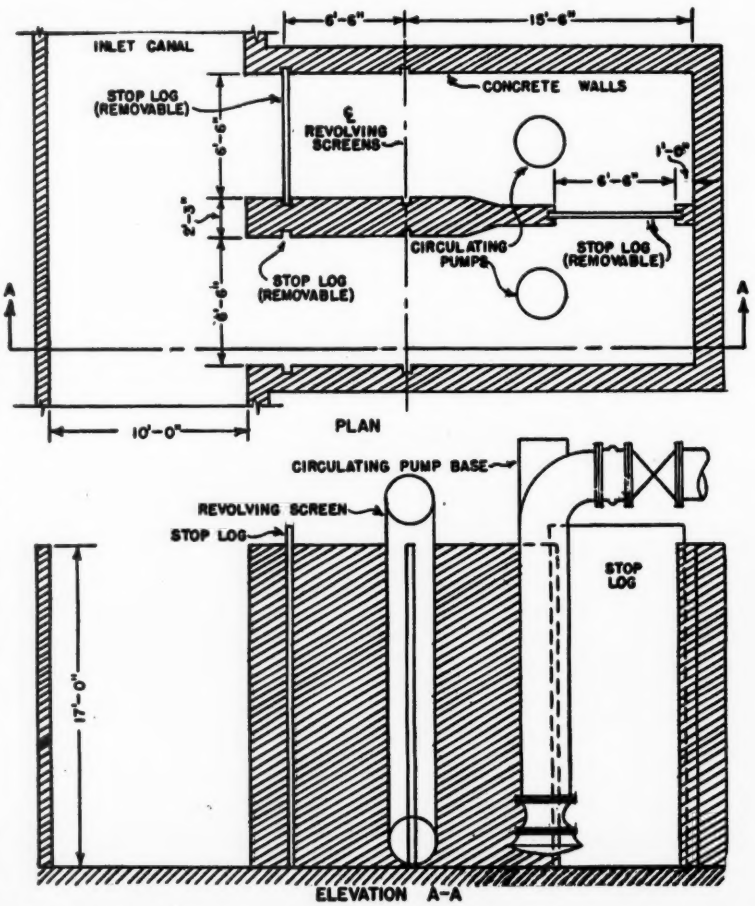
2. APPLICATION OF HEAT.

The intake pit was closed with the stop logs. Steam was introduced at the bottom of the pit through two 1 in. pipes. Approximately three hours were required to raise the temperature of the water from 65F to 145F. The steam was shut off, and the water allowed to stand for one hour.

An inspection of the screen on the following day showed excellent results. As expected at this temperature, all barnacles were dead. This hot water was allowed to slowly mix with cold water that was being supplied to the condenser. An instantaneous slight drop in vacuum was noted, but the effect of the hot water was gone within five seconds.

This method was tried on the basis of the paper "Control of Fouling Organisms in Fresh and Salt Water Circuits" by Mr. John G. Dodson. He mentioned that a plant in Scotland obtained successful control of *Mytilus edulis* by heating the water to 120F. Nothing was given on the temperature rise required to kill crustacea or mollusca. It was also known that some plants regularly reverse the direction of cooling water flow to the condenser.

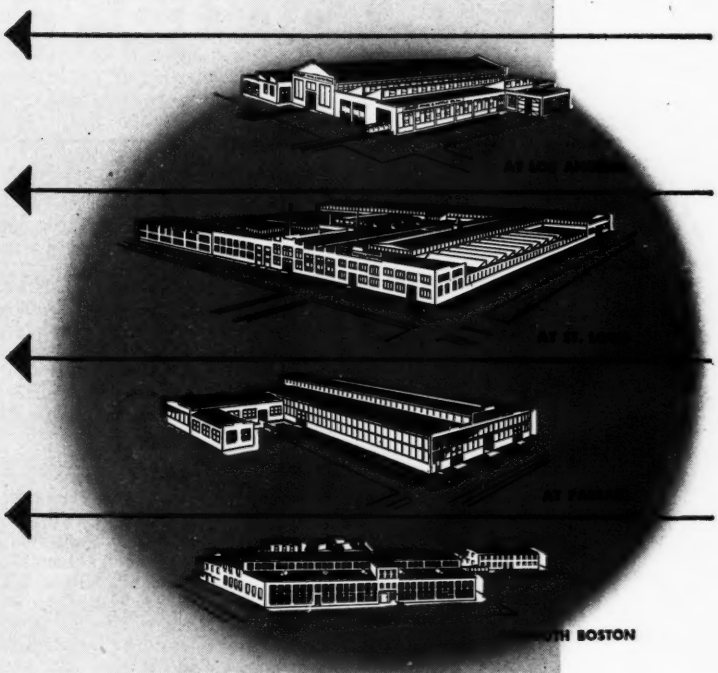
Previous to the cleaning period given above, a trial application had been made on one pit. Only one 1 in. pipe with steam from a header containing steam at 270 psig was used. It required three hours to raise the temperature of the water from 65F to 110F, and practically no increase



Plan and elevation of the intake pits showing arrangement of revolving screens and circulating pump intakes

TO THE USER OF FABRICATED PIPING

4 PLANTS *Are Better* THAN 1



There are four Midwest pipe fabricating plants located in different parts of the country, because Midwest has found that "four plants are better than one" for the user of piping.

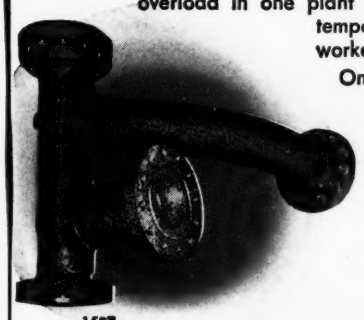
In addition to shortening shipping distances and making for a better understanding of the customers' individual problems, four plants provide other important benefits in which all Midwest Piping users participate.

Extra reserve capacity is provided for the emergency job. If extreme speed is sufficiently important, a job can be divided among two or more plants. An overload in one plant often can be handled by temporarily transferring skilled workers from other plants.

One of the greatest advantages is the continuous exchange of information and experience between staff members of the four plants. New techniques developed in one plant are made known to all. Piping problems which may be new to one plant probably are very familiar to another where the "know how" information is available at once. Friendly rivalry—constant study of piping problems by four organizations—tends to advance the art of piping fabrication much more rapidly than would otherwise occur.

All of this works to the advantage of piping users —four plants are better than one.

Midwest can give you better piping and better service . . . whether you need only a simple bend or the most elaborate piping job completely erected and ready for operation.



1527

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Subsidiary: Lumsden & Van Stone Co., South Boston 27, Mass.
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PIPING FABRICATORS AND CONTRACTORS

in temperature was obtained during another hour of application of steam. An inspection of the screen on the following day showed that approximately 50 per cent of the barnacles had been killed. This was an increase of 45 deg with a one hour soaking period at 110F. In view of this, the second steam pipe was provided.

From indications of plant results, it appears that approximately 12,000 lb per hr of steam were used per intake pit. On the basis of a treating period of four hours, this is equivalent to ten barrels of Bunker "C" oil per intake.

3. APPLICATION OF COPPER SULPHATE. A visit was made to a plant in this vicinity that was successfully controlling marine growth with periodic treatments of copper sulphate. Due to their results and no appreciable corrosion in over a year, it was decided to try this.

One intake pit was closed off and 100 lb of commercial powdered copper sulphate crystals were put in. On the basis of 144,300 lb of water, this gave a theoretical copper sulphate residual of 690 ppm. The first pit treated was allowed to stand one and one-half hours. The screen was rotated for twenty minutes, then half of it was left in the water for thirty minutes and the other half for thirty minutes. A small portable pump was used to circulate the water from one end of the pit to the other.

An inspection of the screen on the following day indicated a very few barnacles still alive. The same procedure was followed on the second intake pit, but it was allowed to stand two and one-half hours. The results obtained were practically 100 per cent.

Since copper sulphate cost is $10.00 per 100 lb in small lots, the cost of cleaning the two intake pits was approximately half the cost of steaming them.

As to the actual costs, including loss in turbine efficiency, there was a loss in vacuum of 0.60 in. Hg. This was equivalent to an increase of 1.4 per cent in water rate as shown by turbine manufacturer's expected data curves. On the basis of a cost of 0.5 cents per kwh, the lower vacuum experienced for a total of ten hours for the heating method would amount to approximately $22.00. The amount of oil equivalent to steam used was twenty barrels, so that cost was approximately $42.00. Since the work was performed by the maintenance crew during regular hours, no cost was included for this. Therefore, the total for steaming two intake pits was $64.00.

The method of using copper sulphate required only eight hours for both intake pits including putting in and removing stop logs. Therefore, the cost due to loss in vacuum was $17.60. Since the cost of the copper sulphate was $20.00, the total cost was $37.60.

Previous operation has indicated that without some method of killing barnacles, they would grow in formations thick enough in six months or less, to break off in pieces large enough to plug condenser tubes. After this condition exists, it is necessary to clean the inlet tube sheet every four or five days. If the barnacle growth is controlled at a minimum, it normally requires about one cleaning every three weeks to remove grasses, etc., that get by the screens. Since there is more rapid growth in summer than in winter, it is planned to treat these intake pits about every six weeks in summer and every three months in winter, depending upon the growth on the screens.

Assistance of Mr. R. F. Marr, Chief Engineer, and Mr. R. E. Joh, Assistant Chief Engineer, and the maintenance crew was greatly appreciated.

THE PHILLIPS AIR ENGINE

IN 1937, research scientists of the N. V. Philips plant at Eindhoven, Holland, turned their attention toward the air engine because of the firm's need of a small, light, and simple machine, devoid of radio-interference devices, to drive generators for powering radio receiving and transmitting stations in regions where electricity was not available. Several small Stirling air engines were secured and submitted to the laboratory for testing. This research work, which was continued in secrecy during the German occupation, has resulted in a line of air engines of extremely interesting design and characteristics ranging in size from fractional to 200 hp. Facts regarding them have been published in the *Philips Technical Review*.

The improvement over the classical air engine is evident when it is considered that a 2-bhp unit of 1923 weighed 1500 lb and had a swept volume of 1500 cu in., while a modern machine of the same capacity is reported to weigh only 30 lb and to have a displacement of only 12 cu in. In addition, the latter has a thermal efficiency several times greater.

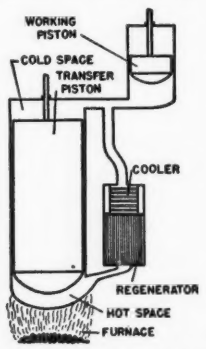

Fig. 1. Working principle of original Stirling air engine shown in this diagram of model produced about 1840

Piston rods of both cylinders connected to horizontal beam that drives crankshaft. Cooler consists of nest of copper tubes through which cold water circulates, while the regenerator is of closely-spaced plates of sheet iron. Compressed air at 150 psi is initially charged into cold space. At up stroke of the transfer piston, air is forced from cold space through cooler and regenerator into hot space, working piston being stationary. Air picks up some heat from regenerator, and is further heated in hot space. This increases pressure of air in entire system, causing working piston to move upward and do useful work. Transfer piston then descends, forcing air out of hot space through regenerator and cooler. Most of its excess heat is left in regenerator, and more is extracted by cooler. Cool air in upper space is then compressed on down stroke of working piston, and cycle is repeated.

In the new engine, developed mean effective pressures of 10 atmospheres or higher have been obtained with working speeds up to 3000 rpm. The maximum air pressure is 50 atmospheres (730 psi), while the temperature of the hot air reaches 1200 F. The cylinder in which external combustion takes place is well screened to safely confine the heat and cylinder walls are made from heat-resisting steel alloys.

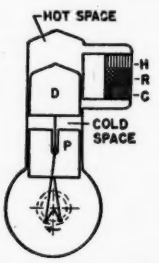

Fig. 2. Diagram of modern Philips version of vertical single-cylinder air engine, with transfer piston or displacer located above working piston. This model designed for output of 1 hp at 2000 rpm. H=Heater. R=Regenerator. C=Cooler. P=Piston. D=Displacer.

Philips has developed an entirely new type of regenerator. It consists of a coil made of finely-drawn, heat-resisting wire approximately 0.002 in. thick. The unit will raise the temperature of the air flowing through it from about 212 to 1112 F within a 0.01 sec with an efficiency of 95 per cent or better, while offering little resistance to the flow of air. In fuel consumption per horsepower-hour, the Philips engine occupies an intermediate place between the best gasoline engine and the Diesel, says *Compressed Air Magazine* in reporting on the engine.

Among the advantages of the air engine: Gasoline, kerosene, methyl alcohol, fuel oil, or natural or manufactured gas can be used as fuel and, as it is burned externally, combustion is complete; no intermitent explosions in cylinders, runs quietly; cylinders and pistons of air engine kept relatively cool and the air clean, so that wear due to high temperature is avoided; ignition and fuel-injection systems not required, maintenance simplified.

WHAT CAUSES

IN BOILERS?

The principal causes of corrosion in boilers are acidity (low pH) and dissolved oxygen. In some cases electrolytic action and high alkalinity are factors that have to be considered.

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3. Warren builds practically *all types* of centrifugal and reciprocating pumps and will engineer special pumps for special purposes.

4. Warren ranks well among pump builders as to size, organization and facilities.

5. Warren bows to no one in selecting the right pump for the job. "A Warren recommendation is never a compromise."

6. Our customers include many of the famous names throughout industry.

7. Warren pumps are fairly priced—but not built to a price. Initial cost is insignificant when measured against results.

8. Warren pumps are guaranteed—not only as to quality and workmanship, but also for performance as rated when shipped. Maintained efficiency is inherent in every Warren design.

Why not put your pump problems up to Warren?

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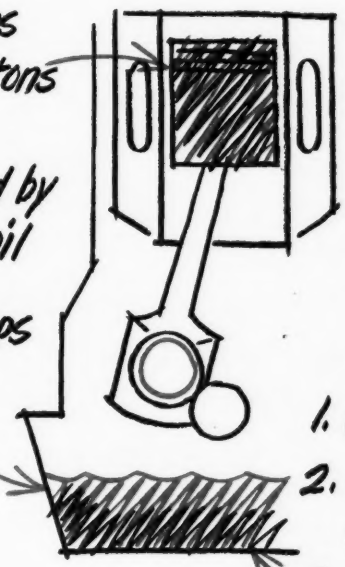
LUBE MEMO

Crankcase Sludge causes Hot Lube Oil troubles

Hot oil oxidizes fast, gums pistons

Sludge formed by ordinary lube oil insulates crankcase, keeps oil hot



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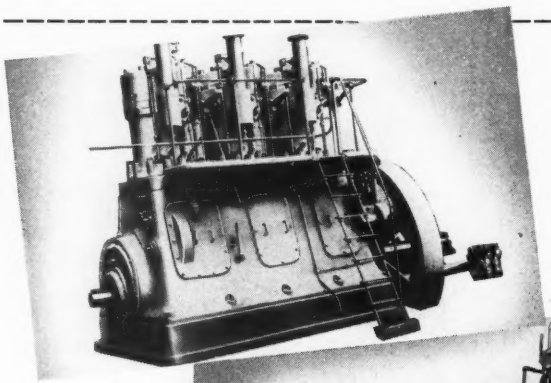
1898...

WORTHINGTON'S MR. GRACE SEES A GOLDEN OPPORTUNITY

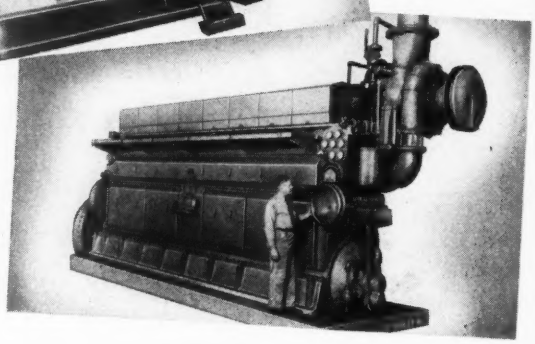
...1948

WORTHINGTON CELEBRATES DIESEL'S GOLDEN ANNIVERSARY



1902

An early American Diesel, built by the Power and Machinery Corporation, a Worthington subsidiary.



1948

A Worthington Turbo - Charged, Dual Fuel Diesel of today; Type SEHGO-8, 16 x 20, developing 1645 bhp at 360 rpm.

WORTHINGTON

Just 50 years ago — in May, 1898 — the first Diesel engine imported from Germany was shown at "The Electrical Exposition" in New York's old Madison Square Garden.

Present were Mr. J. F. Grace, a Worthington engineer who is still active in the corporation, and his brother, Richard J. Grace, then of the Worthington Testing Department, now War Department Engineer at Portland, Oregon. Young J. F. Grace's intense interest in the new 40 hp, single-cylinder engine soon spread throughout the entire Worthington staff. And as early as 1902 a Worthington subsidiary was building engines for the Diesel Motors Company of America, holders of exclusive rights in the U. S.

By 1912 Worthington was building Diesels for itself, from its own designs. Ever since, Worthington has been a leading producer of Diesels, and has introduced many new improvements which have advanced Diesel design and manufacture the world over.

Today, Worthington Diesels of many sizes and types are supplying low-cost, always dependable power to a vast range of applications. On land and sea they are daily proving that Worthington's outstanding experience in Diesel building and development pays off in better engine performance. . . . For further proof that *there's more worth in Worthington*, write to *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.*

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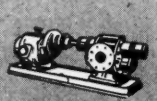
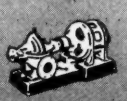
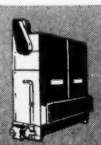


Oil Transfer Pumps

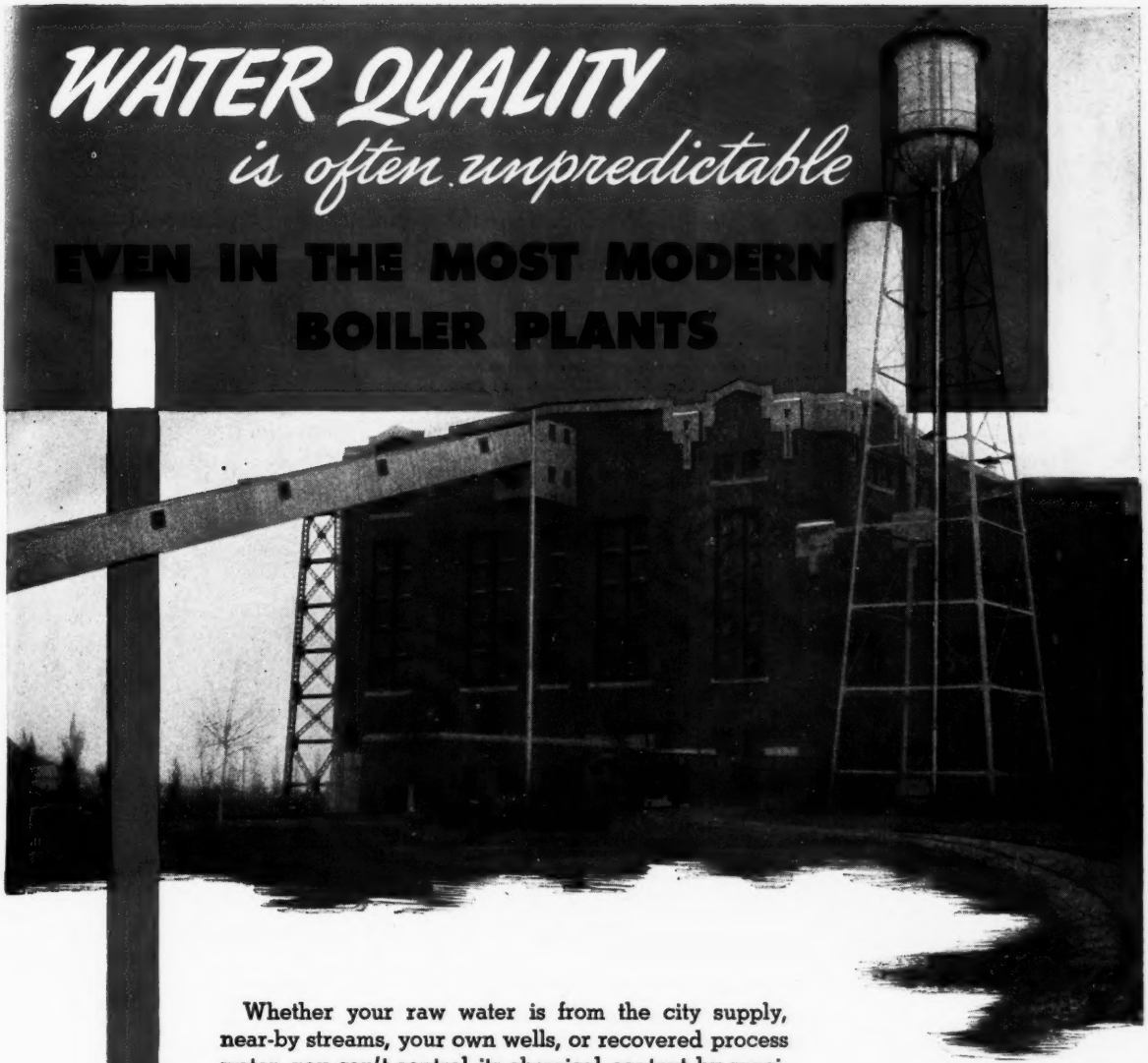


Cooling Water Circulating Pumps



Evaporative Type Engine Water Cooler

WATER QUALITY
is often unpredictable
EVEN IN THE MOST MODERN BOILER PLANTS



Whether your raw water is from the city supply, near-by streams, your own wells, or recovered process water, you can't control its chemical content by specification. It's the innocent looking saboteur which in its untreated or improperly treated states can clog boilers, increase steam costs, and cause overtime for boiler cleanouts. Fortunately, this bad actor can be made to work efficiently by proper treatment and careful scientific test control.

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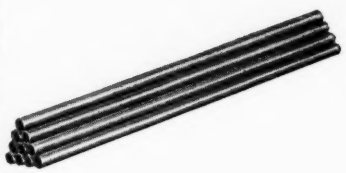
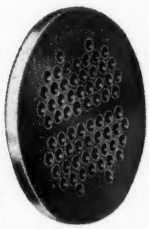
by compensating for effects of tube fouling, load fluctuations and varying climatic or operating conditions





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For a simple explanation on how Ross achieves these factors of safety with standardized units, write for a free copy of illustrated BULLETIN 5322. Then, you'll insist upon Ross.

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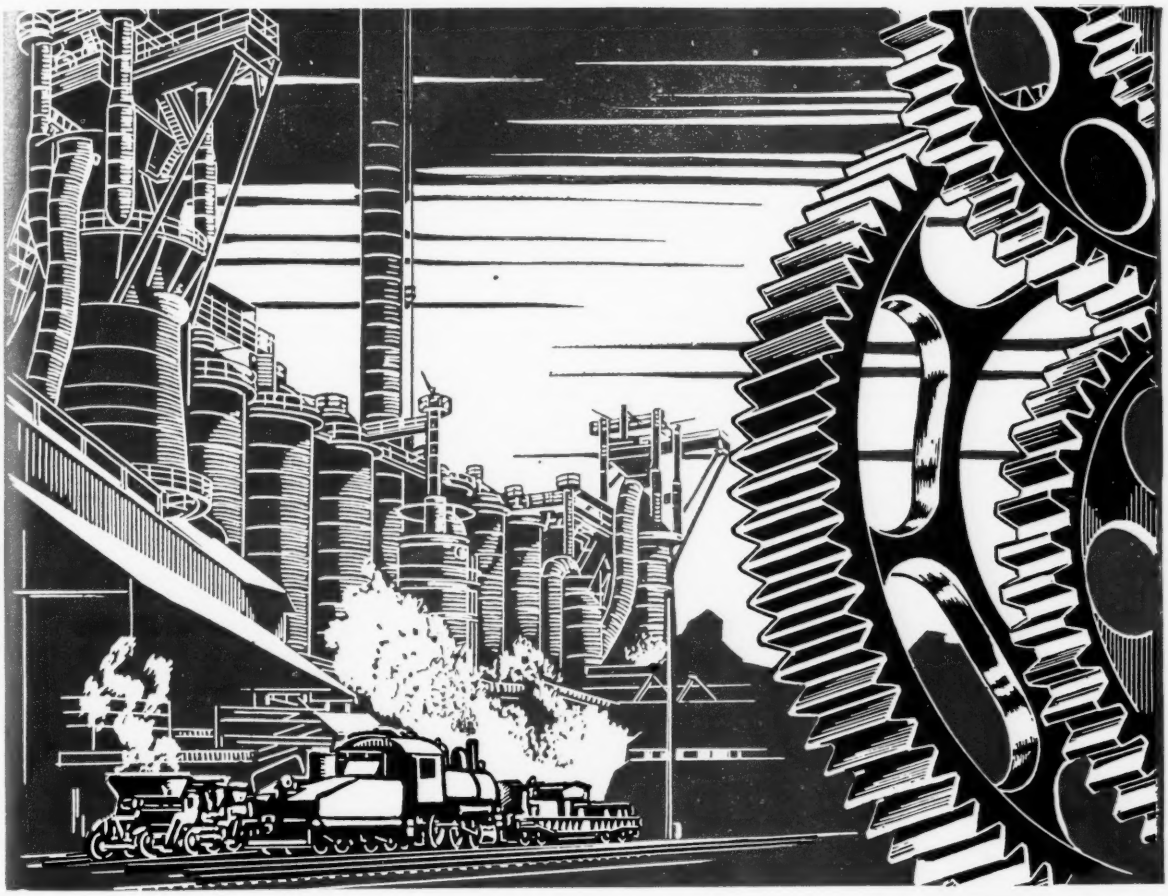

Tycol Engineered Lubrication performs better because:

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When air accumulations collect in high points in the line, the usable cross section area of the pipe is reduced and induces a friction factor—lowering the pumping capacity of the entire line.

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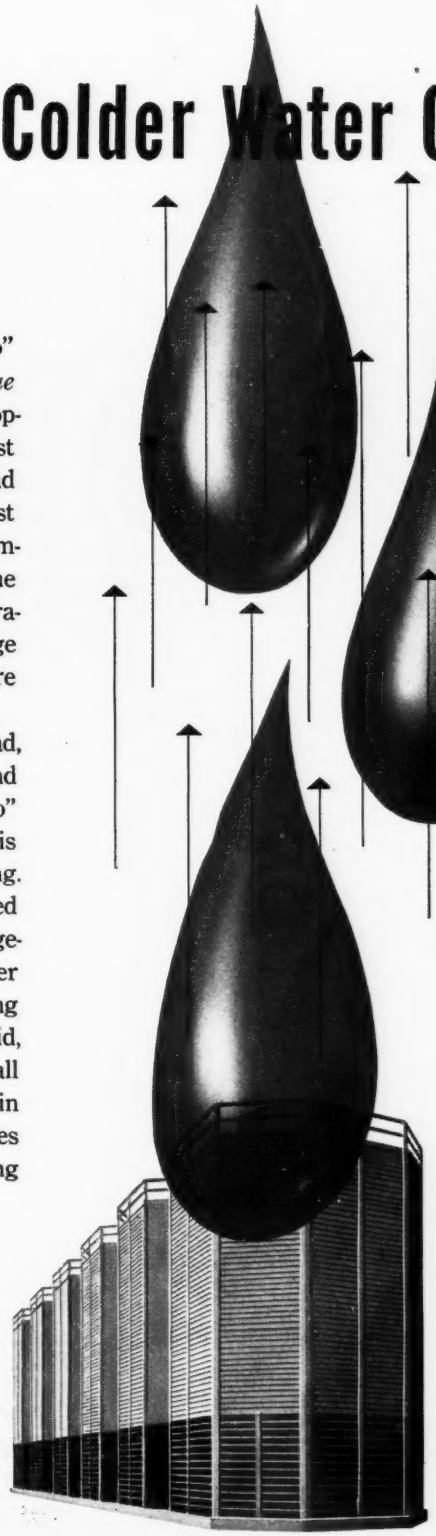
Cheaper? Yes, and here's why: Fluor "Counterflo" Cooling Towers incorporate the principle of *true* counterflow: the air current travels directly opposite to the water current. Result? The coldest air contacts the coldest water; the hottest and most humid air (exhaust) contacts the hottest water. All the exhaust air approaches the temperature of the incoming hot water while all the cooling water approaches the wet bulb temperature of the entering air...thus taking advantage of the greatest possible terminal temperature differential so vital to efficient heat transfer.

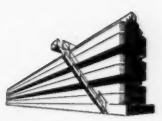
Assuming tower size, tower height, heat load, water circulation, wet bulb temperature and air quantity are equal, the Fluor "Counterflo" Cooling Tower will deliver colder water than is possible with either parallel or crossflow cooling.

The Fluor octagonal tower design; patented up-spray distribution nozzles; proper arrangement of grid decking to assure longer air-water contact; fan and gearing developed to give long service life and eliminate recirculation; rigid, time-resistant construction throughout... all add up to one net result: less operational cost in the long run. Yes, fifty years' experience proves that... year in and year out... Fluor Cooling Towers deliver colder water cheaper!

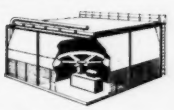


6 Cell "Counterflo" Cooling Tower

Fluor "Counterflo" induced draft cooling towers, prefabricated in mass production, are available in multiple or single units in any required size or height.



Fluor Areator atmospheric cooling towers are recommended where this type is the most practical.



The Fluor Fin-Fan cooling unit has a wide, economical range of utility throughout industry.

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ADSCO ROTARY METER
PATENTED
AMERICAN DISTRICT STEAM COMPANY
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SIZE 250 SERIAL NO. 9460
ADSCO Rotary Condensation Meter is the low cost answer to the accurate metering of steam after it is condensed. Thousands in use to determine monthly steam consumption per building, department or process. Operates under vacuum or gravity flow. Counter reads directly in pounds. Available in 7 sizes from 250-12000 lbs. per hour.
Write for Bulletin No. 35-80B.
FLOW METERS
ADSCO also makes flow meters for steam, water, air or gas metering as illustrated at left.
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AMERICAN DISTRICT STEAM CO.
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SINCE 1877

NEW ENGINEERING BOOKS

Power System Stability, Volume I—Elements of Stability Calculations, by Edward Wilson Kimbark. First Edition; 355 pages; 6 by 8¾ inches; cloth; illustrated; published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York; 1948. Price $6.00.

Of all the problems involved in the operation of large electric power systems, those concerned with stability are the most important. For it is the stability limit, particularly the transient stability limit, that determines the capacity of the system. A number of years ago, one of the Chicago Sunday papers published a vividly colored map of the United States on which was depicted graphically a long transmission line extending from New York to San Francsico. The map showed huge generating stations feeding into the line and at other places load was tapped off for farm and factories. It was an artistic job—it had public appeal—but there was one thing wrong with it—it wouldn't work.

The early problems of parallel operation were concerned principally with the phenomenon of hunting. In the early years of the electrical industry, parallel operation of symmetrical machines was accomplished in isolated instances. The hunting problem, however, did not assume importance until after the change from belted machines to engine-driven machines, and from smooth to slotted armature construction. About this time the necessity for parallel operation became general and the hunting problem became serious. The cause was not well understood. It was variously ascribed to the presence of harmonic circulating currents to the pulsating torques of prime movers, etc. Considering the complexities of these problems, particularly during the transient conditions involved in hunting, it is not surprisng that the state of the art at that time made exceedingly difficult the determination of the true cause of hunting.

Gradually, however, these problems were understood. As large constant torque prime movers came into use and as systems became larger, disturbances arising from the peculiar characteristics of an individual machine decreased and the hunting problem greatly decreased in seriousness.

Another type of problem made its appearance however. The one involving the ability to maintain synchronism both during steady state conditions and during transient conditions. This problem, called the stability problem, is concerned with power links and is distinct from the hunting problem which is characterized by periodic phenomenon.

Since these problems first made their appearance, they have been given a great amount of study and many papers and books have been written on them. The subject is one of great complexity. Indeed, on a system involving a number of generators the solution of the stability problem would be practically impossible without the aid of the calculating board.

The importance of system stability has given it a high place in system design and in recent years, mutual understanding of the subject by both operator and manufacturer has resulted in steady progress in the solution of the more difficult problems. Despite the increased knowledge now available, systems are occasionally extended without full consciousness of the stability factor until a serious system disturbance brings the problem to the front. System Engineers, therefore, must be able to foresee the relative probability of the occurrence of combinations of undsirable conditions and this requires a knowledge not only of stability theory but also of modern equipment. Modern theories of stability involve a knowledge of the use of symmetrical components, the two-reaction theory of synchronous machines, the network analyzer method of system representation, etc.

Only the general elements of the stability problem are covered in this first volume. Equipment such as circuit breakers and protected relays will be discussed in a second volume. The author feels that the publication of such material in a second volume will make it more useful to persons who are interested in power system protection even though they may not be particularly concerned with subject of stability.

This book is particularly suited to those who need a good general introduction to the subject. It opens with a brief clear statement of the stability problem and a review of the development of methods for attacking this problem. This is followed by a chapter on the swing equation which is a differential equation governing the motion of each machine of a system. The formal solution of this equation is extremely difficult and so the so-called point in point solution is described in detail by means of several interesting examples. Chapter 3 is a continuation of the discussion of the swing equation but as applied to the solution of the network to which the machines are connected.

The equal area criterion for stability forms the substance of Chapter 4. This is a simple graphical method for determining whether a system is stable. It saves much complication and is very useful.

After further consideration of the problem of two-machine systems, in Chapter 5, Chapter 6 takes up the solution of the faulted three-phase networks. This introduces and applies the method of symmetrical components and describes the effect of various types of faults on system stability.

Finally, Chapter 7 is devoted to typical stability studies. This is a particularly valuable chapter since it describes actual cases taken from the records of power companies. These studies are complete in every detail with maps, tabulated lists of machines, sequence networks, etc. Both student and practical engineer will find this chapter of value because it shows exactly how the stability theory and methods discussed in the first part of the book are applied in the actual solution of problems.

On the whole this is a most excellent book. The author knows his subject thoroughly from both practical and theoretical standpoint. A graduate of both Northwestern University and the Massachusetts Institue of Technology, he is now Professor of Electrical Engineering in the Northwestern University Technological Institute.

Heating and Ventilating Buyers' Directory; 1948 edition; 320 pages, illustrated; 5⅝ by 8¼ in. paper binding; published by the Industrial Press, 148 Lafayette Street, New York 13, N.Y. Price $1.00

The 1948 edition of the Heating and Ventilating Buyers' Directory covers the fields of air conditioning, piping, heating, refrigeration, ventilation, air sanitation. It is primarily a product directory, listing the names of manufacturers or sources of supply of equipment, supplies and services.

A trade name section includes both current and obsolete trade names together with the product with which it is associated and the name of the manufacturer. Street addrsses of manufacturers are listed separately in the closing section.

THE BIRD-ARCHER 8-POINT WATER TREATMENT SERVICE

1. *Study of all available water sources*
2. *Plant Survey*
3. *Laboratory Service for scientific analysis*
4. *Development of treatment and control systems*
5. *Instructing plant staff in the operation and control of the treatment system*
6. *Furnishing properly prepared treatment materials*
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8. *Regular check-ups by service engineers*

It's wind—not steam—that furnishes the power for this Dutchman's mill. Water treatment won't boost his power-plant's efficiency . . . but a little lubrication might. At least it will quiet the squeak and squeal of circling sails.

But no amount of oil will help where water for cooling, process, or power is causing trouble. You won't hear any squeals from scale-coated tubes or corroded equipment . . . but you *will* see a drop in efficiency . . . a boost in operating costs . . . excessive replacement expenses.

Bird-Archer can call a halt to these water treatment headaches by applying proved treatment methods . . . the result of more than 60 years of specializing in solving water treatment problems.

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CYLINDER OPERATED

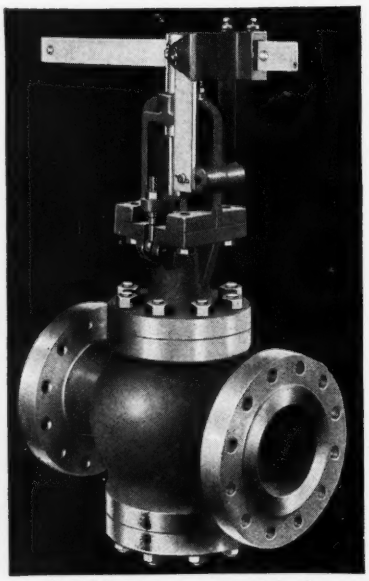
Republic cylinder operated valves are of the gradual opening, high lift, double seated type. They are hydraulicly operated to assure smooth performance at any speed regardless of size, static pressure or pressure reduction. These valves are available in sizes from 3" to 24", with or without hand operating wheel. Due to compact design, a regulator may be mounted directly on the valve.

HAND OPERATED

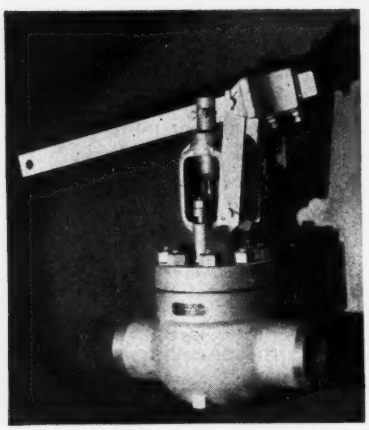
Republic hand operated valves, in sizes from 1" to 8", are built to 900 lb. and 1500 lb. pressure standards. Sizes up to 2" are also available for 600 lb. pressure. They are of the single seated type, have a one piece valve stem, and seat rings that are Stellite surfaced. On the larger sizes the gear reduction head is built with ball or roller bearings and precision ground gears for minimum friction and back lash.

For your key jobs, where valves must not fail—where they must continuously and accurately regulate the pressures and flows of steam and water on which other vital processes depend—Republic valves give you the dependability you need.

Let a Republic Engineer consult with you on your specific pressure and flow regulating problems.



Republic 6 in. lever operated valve



Republic 2 in. lever operated valve

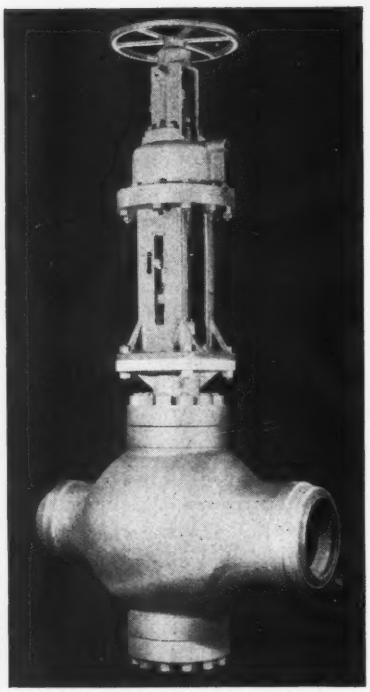
LEVER OPERATED

Republic double seated lever operated valves are available in sizes from 3" to 16" for low pressure applications and in sizes up to 6" for 1500 lb. applications. They are ideal for air actuation with long stroke cylinders. The lever mechanism is of sturdy construction capable of taking full strain of power cylinder.

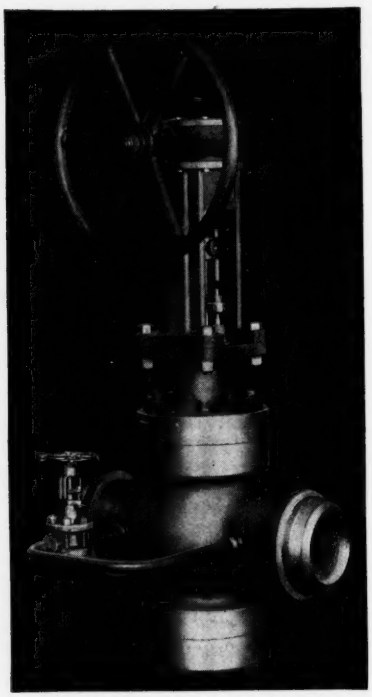
Single seated lever operated valves are available in sizes up to 2" and for pressure up to 1500 lb. standard. The sturdy lever mechanism is adjustable for lift.

BUTTERFLY VALVES

Republic butterfly valves can be supplied in cast iron or steel for pressures up to 300 lbs. Vanes can be supplied of the angle seating or swing through types. The shaft can be mounted on ball or plain bearings as required. A valve operator may be mounted directly on valves of 6" size and over.



Republic 12 in. cylinder operated valve



Republic 6 in. hand operated valve

REPUBLIC FLOW METERS CO.

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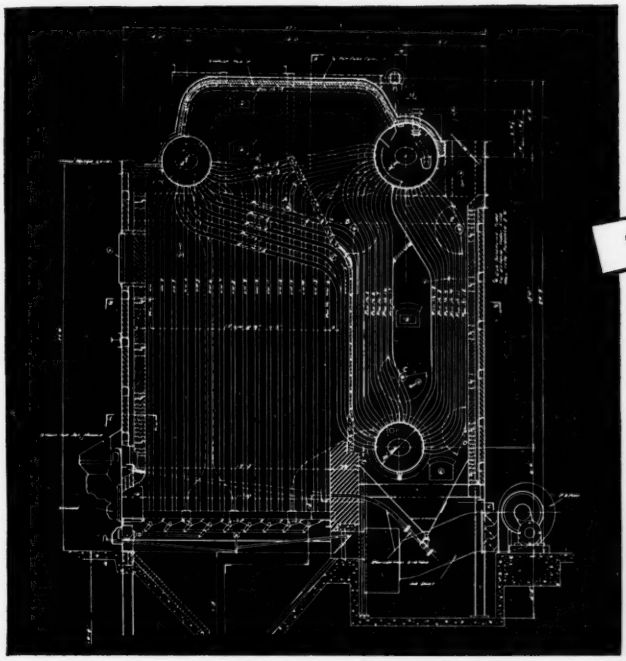
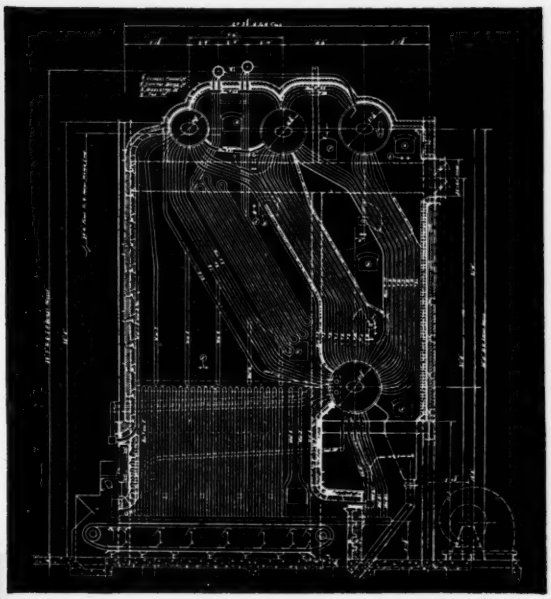
Quick Steaming at all Ratings!



Carry high overloads with high efficiency

SPECIFY **Vogt**

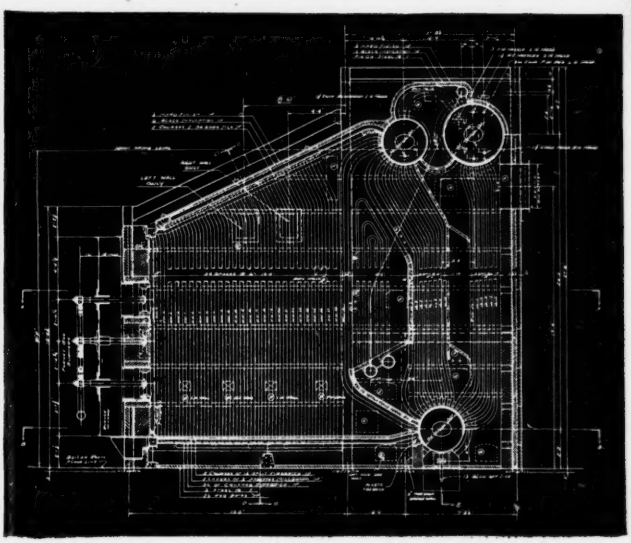
STEAM GENERATING UNITS



CLASS VL — Two 27,500 pounds per hour units, installed at Brown-Forman Distillers Corporation, Louisville, Ky. Features large furnace volume in limited space, with high ratio of radiant heating surface.

CLASS LE — Mt. Carmel Public Utility, Mt. Carmel, Illinois, is served by this 60,000 pounds per hour unit. Generous steam liberating surfaces and steam space permit wide fluctuations in load.

CLASS VR — 70,000 pounds per hour steam generator at Humble Oil and Refining Company, Johnsue, Texas. An efficient, high-duty unit with water cooled furnace, using refinery gas fuel.



Vogt builds a complete line of bent tube steam generators, designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Superheaters, air preheaters, economizers, water walls, and soot blowers can be readily incorporated. Bulletins with general information and showing typical installations are available upon request.

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Here is the CMH contribution to maximum expansion joint life

CMH Controlled-Flexing Expansion Joint
CMH Expansion Joints are Flexonically* engineered to minimize internal stresses and to uniformly distribute working stresses
CMH Free-Flexing Expansion Joint

The corrugations of CMH Expansion Joints are scientifically formed by advanced methods developed through years of experience. Advanced forming methods coupled with carefully controlled heat treating minimize the internal stresses normally developed in fabrication. Working stresses are held in balance by FLEXONICALLY* engineered curvature of corrugations to best distribute the forces resultant in service.

These remarkable design features make possible completely dependable expansion and misalignment control in a compact unit with no maintenance or other service attention.

CMH CONTROLLED-FLEXING EXPANSION JOINTS

Sizes 4" to 24" Inside Diameters. For Pressures up to 300 p.s.i. Temperatures to 900°F. Copper or Stainless Steel Pressure Carriers. Traverse from 5/16" to 6-3/4". Flanged or Welding Ends. Control Rings Corrugation-mated to close working tolerances.

CMH FREE-FLEXING EXPANSION JOINTS

Sizes 4" to 24" Inside Diameters. For Pressures up to 30 p.s.i. Temperatures to 900°F. Copper or Stainless Steel Pressure Carriers. Flanged or Welding Ends.

Get full details today. Write for the new CMH Expansion Joint Bulletin EJ-47.

"FLEXON" identifies CMH products, which have served industry for more than 45 years.

*the science of FLEXONICS..."the controlled bending of thin metals for use under varying conditions of temperature, pressure, vibration and corrosion"...is exemplified in the basic products of Chicago Metal Hose Corporation.

CMH EXPANSION JOINTS

CHICAGO METAL HOSE CORPORATION

Expansion Joint Division • Maywood, Illinois

Plants at Maywood, Elgin and Rock Falls, Illinois

Chlorination . . .

REDUCES CONDENSER "DOWN-TIME"

When high back-pressure due to slime fouling on condenser water-side surfaces results in excessive down-time and costly plug cleaning, the best "doctor" is chlorination. Here's why:

Properly applied chlorination by means of a job-engineered W&T installation is economical. In most cases, the cost of the equipment is saved in the first year.

Chlorination gets at the source of the trouble by killing the micro-organisms that cause slime deposits.

Plug cleaning is eliminated and equipment may be kept on the line thus, in effect increasing station capacity.

Fuel costs are reduced through reduction in average back-pressure.

W&T's more than thirty years' experience in water treatment are always at your call. Write today for a survey of your cooling water system—there's no obligation.

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CHLORINE AND CHEMICAL CONTROL EQUIPMENT
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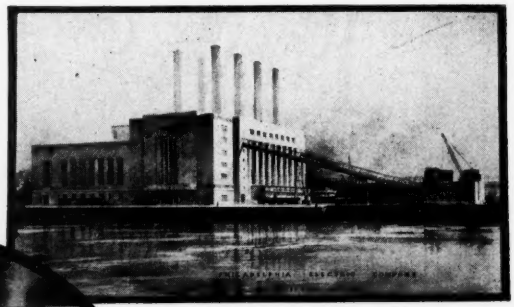
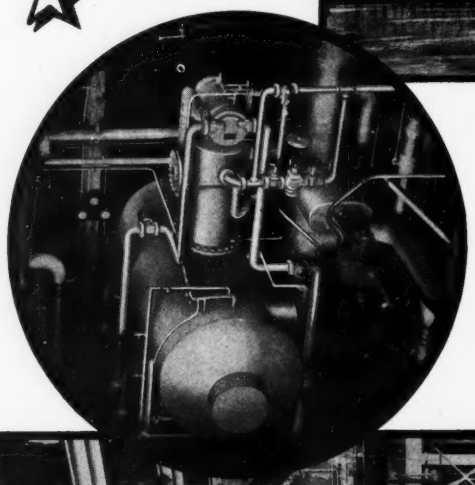
★FAITH IN THE FUTURE★

THE great Philadelphia Electric Company's faith in the future of America and of the important section of America served by its plants, is exemplified in the newest link in its chain of generating stations, the Southwark Station at Oregon and Delaware Avenues, Philadelphia.

Part of the equipment of this great station will be four Cochrane Deaerators.

Selection of Cochrane water conditioning equipment in the far-seeing plans of companies like this all over America, is gratifying evidence not only of faith in the future of America, but in equipment bearing the name Cochrane.





(ABOVE) *Architect's drawing of completed Southwark Generating Station. Design by Philadelphia Electric Engineering Dept., Paul P. Cret Associates, consultants. General contractor, United Engineers & Constructors, Inc.*

(LEFT) *Close-up of one of the Cochrane Deaerators.*

(BELOW) *General view of feedwater heating system with completed Cochrane Deaerator in lower right, with second unit circled in background. Two other units are not visible in this view.*

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COCHRANE

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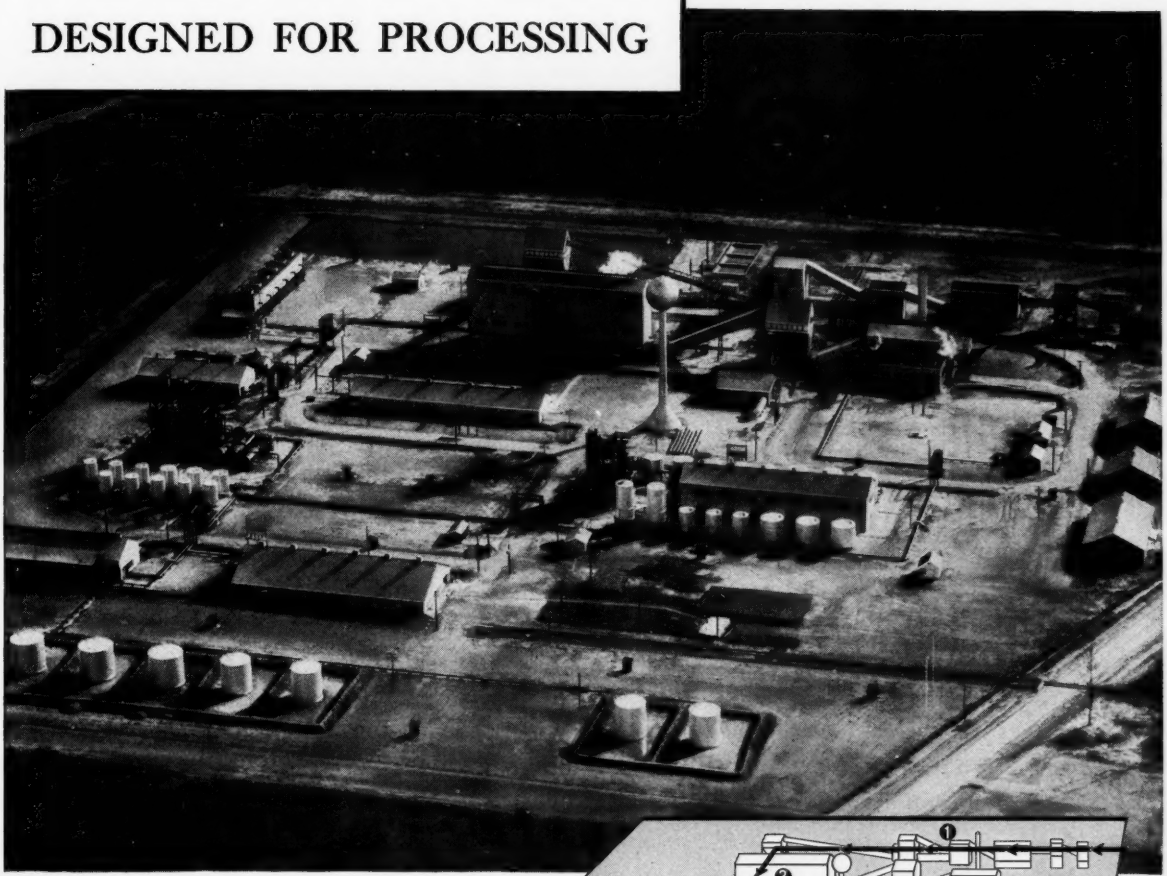
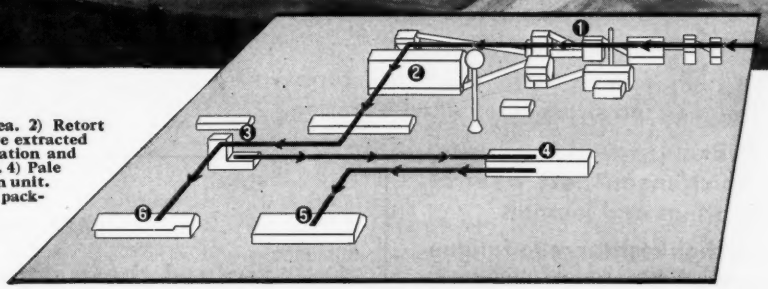


© Photograph by Elwood Payne



1) Wood preparation and grinding area. 2) Retort building where terpenes and rosins are extracted by solvent. 3) Finishing unit for distillation and separation of solvent, terpenes and rosins. 4) Pale rosin decolorization and solution evaporation unit. 5) Rosin packaging building. 6) Oil loading and packaging building.

The Naval Stores Extraction Plant for Newport Industries, Inc., at Oakdale, Louisiana, provides for complete processing of pine stumps, from wood preparation to decolorizing rosin and packaging rosins and terpenes for shipment. Newly developed applications of continuous flow processing, and efficient fractionation result in products of the highest obtainable quality. This plant, with related facilities, was designed and constructed by Stone & Webster Engineering Corporation in collaboration with the engineers of Newport Industries, Inc.

STONE & WEBSTER ENGINEERING CORPORATION

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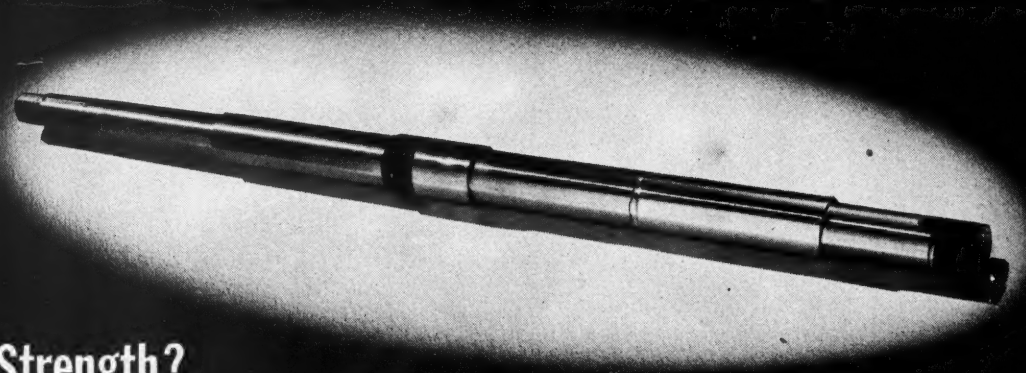
What do you want in a pump shaft?



Strength?
Resistance to corrosion? Hardness? Stiffness?

When you specify *Monel* for pump shafts, you get the combination of qualities needed to combat severe service conditions of wear, stress, vibration, corrosion, and heat. *Monel* insures against frequent, costly replacements; cuts maintenance overhead.

Remember... *Monel* has *all* these features:

- **High resistance to corrosion, corrosion-fatigue, and stress-accelerated corrosion.**
- **Exceptional hardness, which means less wear at bearings and journals.**
- **High resistance to fatigue caused by stress, vibration, and pulsation.**
- **Strength equal to that of steel.**
- **And if you need special properties, there is *"R" Monel* for high-speed production machining; *"K" Monel* that is heat-treatable to tensile strength higher than 150,000 psi; *"KR" Monel* that is both free-machining and heat-treatable.**

For help in solving metal selection problems, send for your INCO NICKEL ALLOYS SELECTOR. This handy slide-rule-type chart tells you at a glance which of the versatile Inco Nickel Alloys will best serve your requirements.

THE INTERNATIONAL NICKEL COMPANY, INC.
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MONEL
solved these difficult problems—

Case 1. In a large metropolitan power plant, the mild steel shaft of a huge circulating pump failed repeatedly because of corrosion-fatigue. Several other metals were tried without success. Then engineers called for "K" Monel. *The result was the world's largest high Nickel alloy pump shaft*—13'x9" dia.!

Case 2. A pump manufacturer had difficulty making long, thin shafts for multi-stage high pressure pumps. Stresses set up during machining caused the shafts to deform and fail in service. Heat-treatable *"K" Monel* was tried—and proved to be the solution to this problem, too.

EMBLEM OF SERVICE
NICKEL INCO ALLOYS MONEL* • "K"* MONEL • "S"* MONEL • "R"* MONEL • "KR"* MONEL • INCONEL* • NICKEL • "L"* NICKEL • "Z"* NICKEL
*Reg. U.S. Pat. Off.

"HAS OPERATED 99% OF THE TIME SINCE 1939"

reports the City of St. Mary's, Ohio, of their first 2500 K W Worthington Turbine Generator.

New 2500 KW Worthington Turbine Generator recently installed in municipal power plant of the City of St. Mary's, Ohio.

Mr. George Probst
Worthington Pump and Machinery Corporation
Steam Turbine Division
Wellsville, New York

Dear Mr. Probst:

You will be interested, I'm sure, to learn that our new 2500 KW Worthington Turbine Generator has been running continuously since it was put on the line about six months ago.

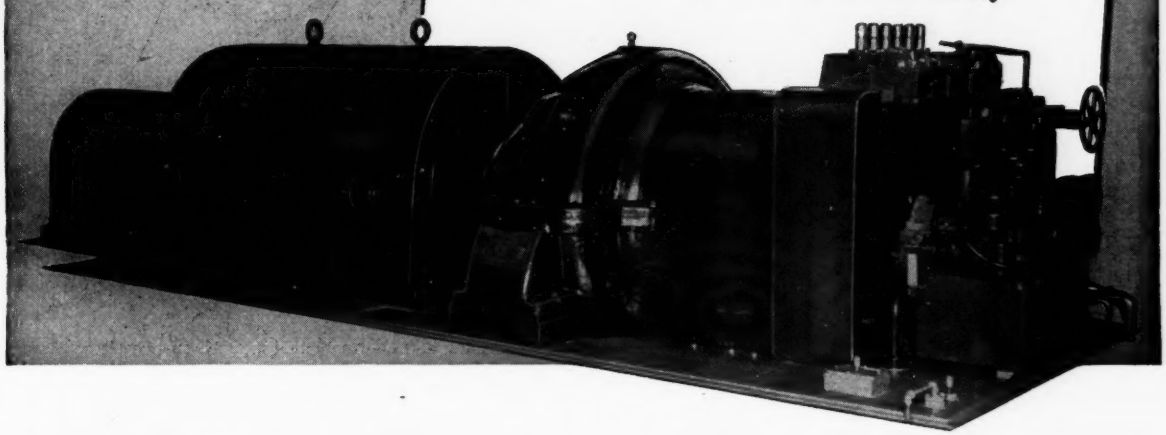
It's been eight years now since our original 2500 KW Worthington unit was started and it has operated 99% of the time ever since. On a number of occasions, it has carried loads of 3000 to 3500 KW for periods of three to four hours. We run both units a large portion of the time and they parallel very nicely.

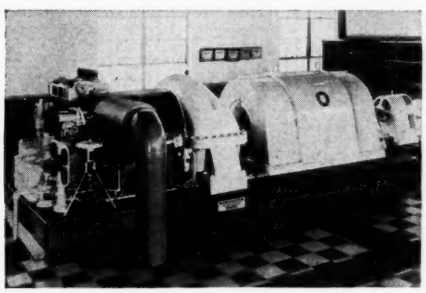
In fact, we do so well with these Worthington units that we would be glad to show them in operation to any of your prospective customers who care to visit our plant.

Very truly yours,
CITY OF ST. MARY'S

J M Hageman

City Engineer and Director
of Service and Safety





2500 KW Worthington unit installed in 1939. Turbine, straight, condensing type, operates on 400 lbs. steam pressure, 750 degrees total temperature and exhausts into a vacuum of 28"

Many similar reports from power users throughout the country testify to the trouble-free, cost-saving performance of Worthington steam turbine equipment. In your own turbine problems, Worthington specialists are always available for expert technical advice. And for further proof that *there's more worth in Worthington*, write for fact-full literature. *Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N Y.*

WORTHINGTON

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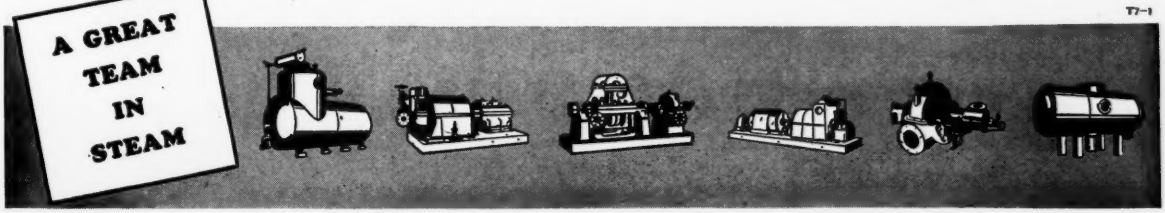
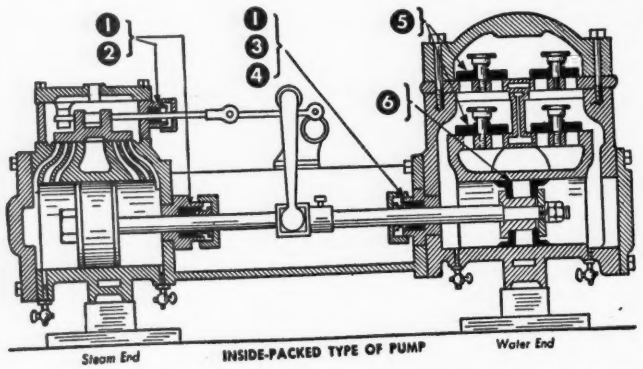
A GREAT TEAM IN STEAM



How to get Longer Service from pump packings

"Put the right packing in the right place" is a simple but effective rule to follow if you would get maximum service life from your pump packings.

A good example of how to do this is shown below. Each of the Johns-Manville Packings listed here was designed to do a specific job . . . and to *stay* on the job for a long time! Use these long-wearing packings on your pumps and you can count on real packing economy—with less time and money spent for *re-packing*.



INSIDE-PACKED TYPE OF PUMP

(1) J-M Sea Rings—outlast ordinary packings because they seal automatically on the work stroke, release on the return.

(2) J-M Kearsarge, Style 166—a durable rod and plunger packing for service up to 500 F.

(3) J-M Cross Diagonal, Style 271 for hot water—Forms a tight seal because it is constructed to allow for expansion in either direction.

(4) J-M Navalon, Style 190 for cold water—contains and retains more lubricant in service; abrasive-free, rot-resistant, resilient.

(5) J-M Pump Valves—Provide perfect seating and long wear, for cold water service and for hot water service up to 300 F.

(6) J-M Moulded Piston Cups—Accurately moulded for precision fit, minimize danger of excessive slippage or tightness.

More complete recommendations, covering a wide range of service conditions, are contained in the Johns-Manville Packing Catalog. Ask your J-M Distributor for your free copy . . . or write Johns-Manville, Box 290, New York 16, N. Y.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville

PACKINGS & GASKETS

COMING EVENTS

EPS—The Second Annual Engineering Progress Show will be held at The Franklin Institute, Philadelphia, May 11 to 14.

Stress Analysis—The Annual Meeting of the Society for Experimental Stress Analysis to be held at the Roosevelt Hotel, Pittsburgh, on May 27, 28 and 29.

Surface Reactions—The Pittsburgh International Conference on Surface Reactions will be held at the Mellon Institute for Industrial Research in Pittsburgh, June 7-11.

NSSC—The Annual Meeting of the National Specialty Club will be held at The Homestead, Hot Springs, Virginia, June 10, 11 and 12.

SMA—The Annual Meeting of the Stokers Manufacturers' Association to be held at the Greenbrier Hotel, White Sulphur, W. Virginia, June 17, 18 and 19.

ASCE—1948 Summer Convention of the American Society of Civil Engineers to be held in the Olympic Hotel, Seattle, July 21-22.

ASTM—The Annual Meeting of the American Society for Testing Materials to be held in Detroit, Headquarters at the Book-Cadillac Hotel, June 21 to 25.

Instrument Society—Instrument Society of America annual meeting to be held in Convention Hall, Philadelphia, September 13-17.

ASCE—1948 Fall Meeting of the American Society of Civil Engineers to be held in the Statler Hotel, Boston, October 13-15.

AIEE—Meetings of the American Institute of Electrical Engineers to be held in 1948 are: Summer General Meeting, Mexico City, Mex., June 21-25. Pacific General Meeting, Spokane, Wash., Aug. 24-27. Middle Eastern District Meeting, Washington, D. C., Oct. 5-7. Midwest General Meeting, Milwaukee, Wis., Oct. 18-22. Southern District Meeting, Birmingham, Ala., Nov 3-5. No headquarters announced

OBITUARIES

JAMES H. McGRAW

JAMES H. MCGRAW, founder and retired head of McGraw-Hill Publishing Co., died February 21 at his home in San Francisco. He was 87 years old.

Mr. McGraw was born in Panama, Chautauqua County, N. Y., in 1860. He attended State Normal School at Fredonia, N. Y., while teaching at district school, and upon being graduated by Fredonia in 1884, became principal of the district school at which he had taught. In 1885 he went to New York, where he joined some Chautauqua friends in the business of publishing industrial magazines. After a disagreement over the policies of the *Street Railway Journal*—(should it recognize the developing electric street railway or stick to the horse-car?)—Mr. McGraw took the *Journal* and formed the McGraw Publishing Co. He organized the McGraw-Hill Publishing Co., in 1915, taking over publications of John A. Hill. Upon his retirement a dozen years ago, Mr. McGraw was head of a great publishing company, including the McGraw-Hill Book Co., and its trade division Whittlesey House.

He was a member of AIEE, ASME and other engineering and business organizations and in 1924 had been awarded the degree of Doctor of Commercial Science by New York University. In 1927 he was awarded the Bok Gold Medal for distinguished service in raising the standards of advertising.

EINER WINHOLT

EINER WINHOLT, retired power engineer for Deere & Co., died February 17, 1948, at his home in Moline, Illinois.

Mr. Winholt was employed by Deere & Co. from 1920 until his retirement June 1, 1945. At the time of his retirement he held the position of Supervising Power Engineer.

He was born in Grenaa, Denmark, May 8, 1885, and until coming to this country in 1909 had a varied career as machinist and marine engineer with the Danish merchant marine.

After two-and-a-half years spent at sea, he went to Chicago, where he was employed as an engineer and attended evening classes studying electricity. In 1911 he became superintendent of a plant, later in the Insull utilities system.

After three years as assistant engineer

in the electrical division of Illinois Public Utilities commission, Mr. Winholt moved to Moline where he was employed as a toolmaker and machinist by the Root and Vandervoort Engineering Co. He also was associated with the Moline Body Works.

In 1920 Mr. Winholt joined the engineering staff of Deere & Co., and was instrumental in effecting many changes in the heat, light and power installations for factory buildings and plants.

An active worker in many civic affairs and fraternal organizations, Mr. Winholt was widely known in the quad-cities. He was a member of the Moline Association of Power Engineers, of which he served as Secretary 20 years; the ASME Brotherhood of America; Swedish Olive lodge of Odd Fellows, the Moline Association of Commerce and the city waterworks advisory committee.

BENEDICT GIFFORD

BENEDICT GIFFORD, president of the Gifford-Wood Co., died suddenly March 22, at New York, of a heart attack.

Mr. Gifford started his career with the Gifford-Wood Co. as a youth, working in the pattern shop during school vacations. Later he was employed in each department in the plant. In 1910 he entered the engineering department, following which he did installation work as an erector, and later he became purchasing agent. In 1914 Mr. Gifford became secretary of the company, then during the following years he was treasurer, vice president and president. He was elected to the latter office at the annual meeting in 1923. He succeeded the late William B. Wood, who had held the position prior to the time of his death in October, 1922. Mr. Gifford had guided the business throughout its growth during the past 25 years.

Mr. Gifford was born June 19, 1889. He received his early education in the Hudson public schools. Later he attended Taft School, in Connecticut, from 1902-1905, followed by two years in Williams College, class of 1912. Then he attended Cornell University for two years.

In 1923 Mr. Gifford was named a trustee of the Home for the Aged. He had served as a president of the board of trustees of the Home for the Aged for many years. Mr. Gifford was a director of the Hudson Boys' Club.

Mr. Gifford was formerly a member of the Hudson Rotary Club and had served as the club's fourth president. He resigned some time ago because of his inability to keep up his attendance because of business reasons.

From May 1, 1932, to April 30, 1935, Mr Gifford had served as public safety commissioner of the City of Hudson. He was appointed by the late Mayor Archland Best.

Surviving are two daughters, Mrs. Orlan A. Johnson, of Stanwood, Mt. Kisco, and Mrs. George Cummings, of New Rochelle; his mother, Mrs. Malcolm Gifford, of this city, and two grandchildren, Gifford Cummings and Ann Cummings.

ELECTRIC POWER AND OUR NATIONAL DEFENSE

(Continued from page 53)

lish normal margins as rapidly as possible. During the 1947 peak-load period in December, this reserve margin amounted to about 5 per cent. As the power projects are completed, it will increase at a faster rate than the load increases. The main reasons why this margin has become small are: First, it has been impossible to install additional generating capacity sufficiently early in the postwar period because of direct war production during the war itself and delays resulting from strikes and shortages of materials. Second, the unprecedented load growth itself has placed demands on the utility systems beyond the predictions of even well-informed people.

The author believes that practical requirements for reserve capability of large interconnected systems should be about 15 per cent of load demands in order to take care of proper operat-

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Located conveniently near you, he is one of 400 industrial distributors who stock Johns-Manville Packings in many sizes and styles. He not only offers you quick service and prompt delivery, but he is ready at any time to assist you with a particular packing problem. His recommendations are based on Johns-Manville's wide experience in the manufacture and application of industrial packings.

Only authorized Johns-Manville Packing Distributors can display the sign shown above. Look for it the next time you need packing!

Your Johns-Manville PACKING DISTRIBUTOR

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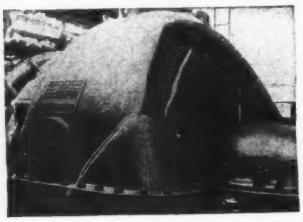
METALOCK REPAIRS

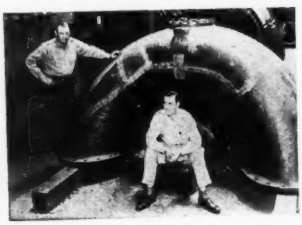
Put Power Equipment Back in Production Quicker, at Lower Cost

Study these views of broken and cracked frames and cylinder blocks. They will give you an idea of the big savings in time and money Metalock casting repair service is delivering in plants all over the country. . . . Metalock repairs, made only by workmen thoroughly trained in this patented process, have been proved and accepted by manufacturers, users, underwriters.

10,000 KW. STEAM TURBINE

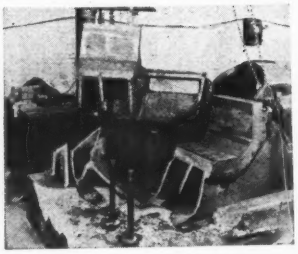
Before **After**

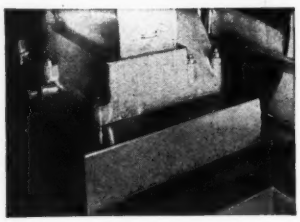




LARGE COMPRESSOR FRAME

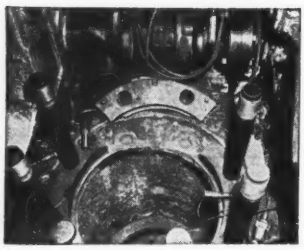
Before **After**

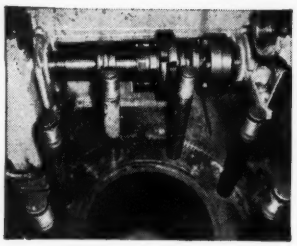




32 IN. DIA. DIESEL ENGINE BLOCK

Before **After**





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ing reserves and maintenance schedules. Isolated systems should have a higher figure. This percentage of reserve should be of sufficient amount to meet all peacetime requirements and in addition should provide a margin of reserve required to meet defense requirements. The amount of the defense part of the reserve margin will depend upon needs and must be discussed with military people conversant with the subject. In contrast to the thinking of some, it is believed that this "defense reserve," so to speak, whether in generating, transformation, switching, or transmission facilities, should be built right into the systems and form an integral part of them. It should be recognized that this is purposely done and with the full knowledge and concurrence of all interested parties—the consumers, the municipal and state regulatory authorities, and the federal agencies involved.

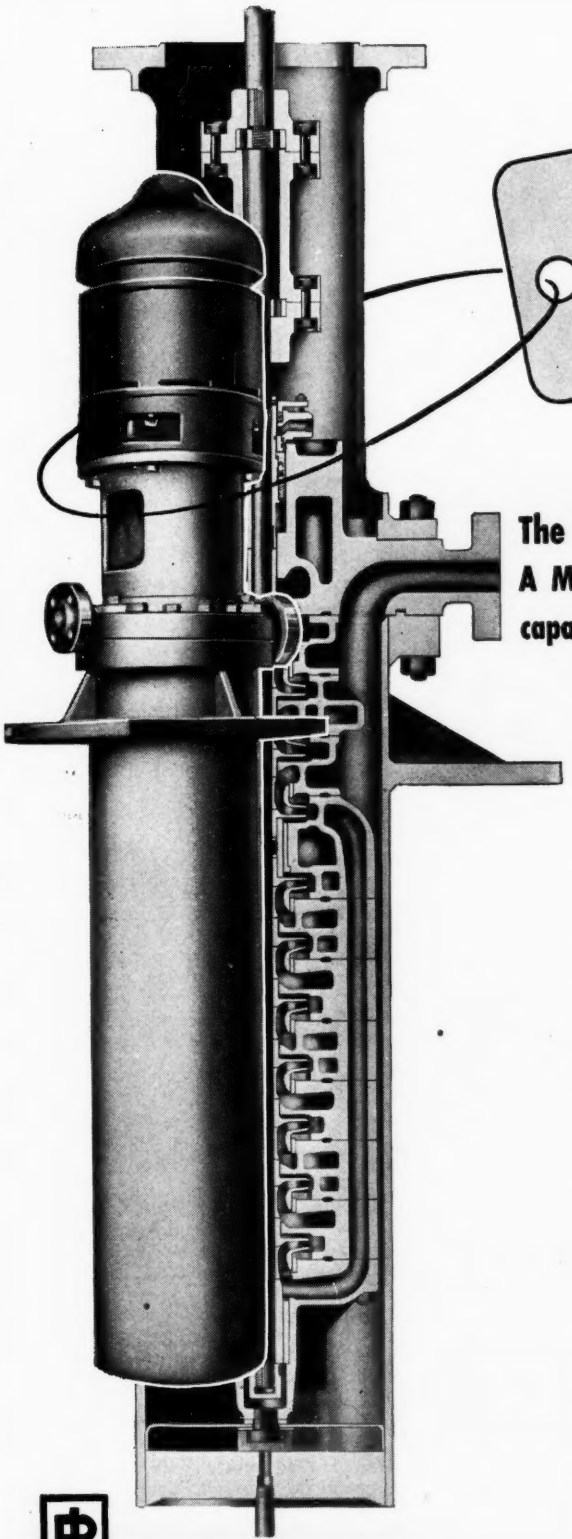
From a national defense standpoint, there should be additional ties between some systems already interconnected and ties between others not yet interconnected. Such interconnections generally could not be justified during peacetime because of the cost involved. However, these are interconnections which ought to be made in peacetime and not be done, as was necessary during the last war, at a time when materials and manpower were vitally needed for other direct war production requirements.

We should not now delay our planning for new construction in anticipation of the early development or influence of nuclear energy. Consequently, our planning and construction should go forward along conventional and presently known means of power generation.

It is the belief of the author that wherever possible generating sources should be decentralized within reasonable limits and large concentrations of generation should be avoided. Underground power plants are not the answer because even they can be damaged from bomb effects, and generally are impractical. Sources of power generation should not be located close to other industrial plants, if it can be avoided, because wartime experience has proved that power facilities, even though not objects of attack, may be heavily damaged because of the wider area affected than just the target itself.

The damage resulting from sabotage is a matter which must not be overlooked. In the future it may be far more important than in the past.

In order that the full electric power resources of the country shall be utilized, if there be need to mobilize industry as was done during the last war, there should be a continuing plan of bringing together qualified personnel from both the industry itself and from the agencies of government concerned. Such an organization and



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The VHT and VHTA Vertical Boiler-Feed Pumps A Must where high pressure and low capacities are needed

The VHT and VHTA units were developed to meet the demand for centrifugal pumps to efficiently handle low capacity, high pressure, pumping jobs.

They have proven themselves to be reliable, sturdy, and well designed pumps.

Internal bearings carry radial loads only; any thrust load developed is carried by the driver. The internal bearings are constantly lubricated by the liquid being pumped. The single stuffing box may be arranged for bleed-off, cold-oil circulation through the packing, or solid packed as the service may require.

Both the VHT and VHTA are multi-stage vertical units with opposed impellers. The pumping elements are made up of sections and as many may be used as necessary to produce the desired head.

Where high pressure, high efficiency and low capacity are desired and where floor space is at a premium, THIS is the pump for the job.

Ask an I-R engineer for further details.

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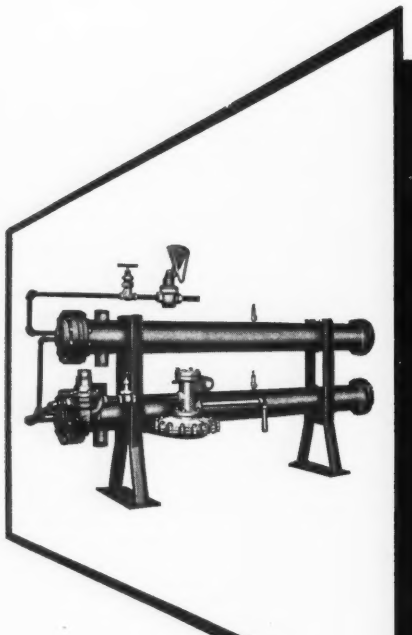
68-10



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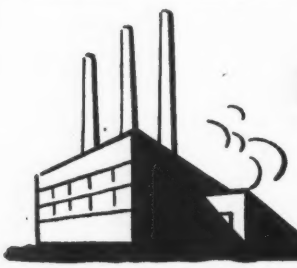
Look at the wide variety of industries that take advantage of the low cost power and clean steam that a Henszey Continuous Blowdown System can provide. That partial list is a typical cross section of American industry. Which means that you, too, should consider a Henszey system in conjunction with your present or planned boilers. The Henszey system keeps boiler water concentration within safe margins — preventing foaming, priming, carryover, and the formation of sludge and scale (with proper chemical treatment). All this is accomplished continuously, automatically, and WITHOUT the heat loss of ordinary blowdown.



Contact your nearest Henszey representative or write to

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staff existed during the last war and could well serve as a model for future action. It was far superior to that which existed in Germany for the same purpose.

Fortunately, our power facilities suffered no damage from enemy action during the past war. But can it be said that we shall always be free from these destructive forces? Or that we shall have time to prepare? And that the oceans are our first line of defense? Today we have become a nation whose borders extend far out beyond our natural land areas. Our military and civilian forces are in occupied areas in Europe and Asia; our efforts in promoting effective peace for hundreds of millions of people are being carried on thousands of miles from home. Whether we like it or not, we are concerned with almost the entire world.

COLOR CONTROL TESTS FOR BOILER WATER

(Continued from page 61)

pare the color of the sample with that of known standard colors representing various values of phosphate in ppm, Steps 6 to 8. The chemistry and calculations are all done for you in the preparation of chemicals and color standards and in sizing and marking of tubes.

Control of Silica

Silica is objectionable in boiler feedwater since it may lead to the formation of hard dense scales having very high resistance to heat transfer. In low-pressure boilers, this scale is largely calcium or magnesium silicate. Softening of the water may be sufficient to avoid its formation. However, in high-pressure boilers, the scale formed is of an entirely different composition and may not depend on the presence of calcium or magnesium. These scales, complex sodium aluminum silicates, are very dense and hard and even in thin layers may cause burned-out tubes when operating at high pressure. Silica in boiler feedwater should be kept as low as possible, under 5 ppm SiO_2, particularly if used in boilers operating at high pressures. Silica may also cause trouble by depositing on turbine blades and in superheaters.

The determination of soluble silica is based on the development of a yellow silico-molybdate color produced by the reaction of the ammonium molybdate in acid solution with the silica present in the water. The color developed is matched with silica standards and the silica content in parts per million of SiO_2 is read directly from the slide.

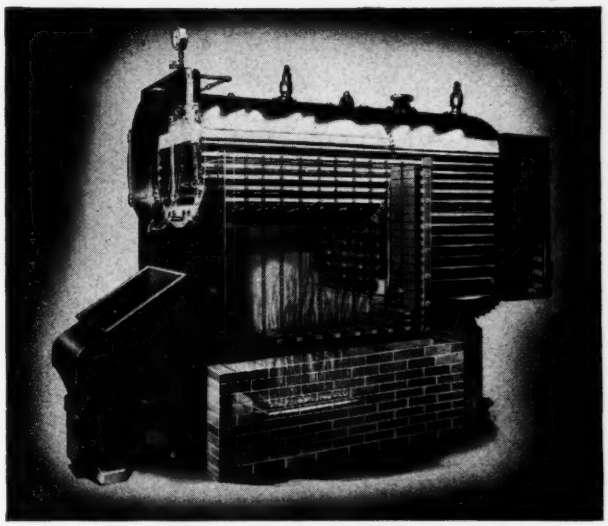
On account of the faintness of the color, a relatively deep layer must be observed so a different type of comparator is used. This instrument is called a Water Analyzer. It is shown

THE ECONOMIC BOILER

THOUSANDS

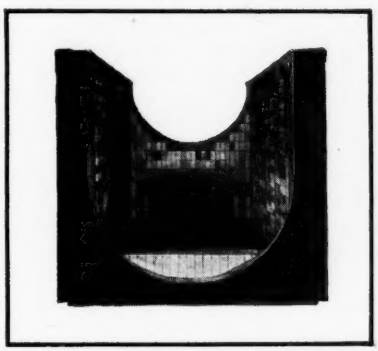
from 20 to 300 hp. in World Service

The Erie City ECONOMIC boiler is the daddy of self-contained boiler-furnace-brick-work units. It is thoroughly standardized and rated according to A. S. M. E. Boiler Code. ECONOMICS are available for 100, 125 or 150 pounds working pressure and are each tested at 50% greater pressure. Each unit is capable of far greater steam output than rated and may be fired by either hand, stoker, gas or oil with only minor setting changes. Write for comprehensive ECONOMIC catalog that describes how rapid steaming, uniform gas velocity, 2000° furnace lining are achieved in this semi-portable boiler.

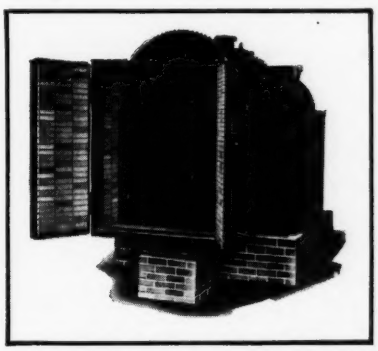


Erie City ECONOMIC complete with Erie City Underfeed Stoker

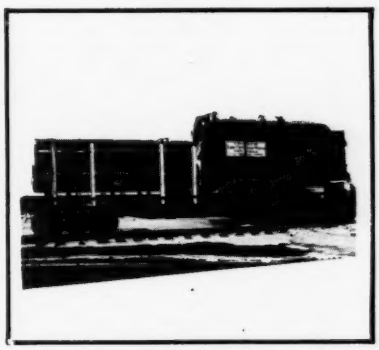
Constantly Improved Over 63 Years



● Standard ECONOMICS feature 9-inch refractory lining installed at the factory. This view shows shaking grates in place. For oil, gas or stoker firing we furnish a 13½-inch refractory lined furnace.



● Looking into rear of an ECONOMIC boiler. Rear combustion chamber doors swing open to provide complete access to all tubes. It's easy to keep this boiler at top efficiency.



● Save costly on-the-job boiler assembly; order an Erie City ECONOMIC; it ships as a complete boiler-furnace-brick-work unit ready to set over ash pit and connect to water and steam lines. 20 to 300 hp.

COMPLETE STEAM POWER PLANT EQUIPMENT

ERIE CITY

Complete Steam Generators ● Type C 3-Drum Boilers ● Type VL 2-Drum Boilers ● The "Economic" Boiler with or without Water Walls ● Welded H. R. T. Boilers ● Welded Steel Heating Boilers ● Coal Pulverizers ● Underfeed Stokers ● Welded Pressure Vessels for the Process Industries.

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2 NON-CORRODING BRONZE SEATS
Dart economy begins with the two precision-ground seats which, being made of bronze, are non-corroding.
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in Fig. 3 and its parts are described in the caption of that view.

Cracking of boiler metal on riveted seams and at tube ends is due to intercrystalline cracking or caustic metal embrittlement. This may result in weakening of the metal structure and boiler failure. The conditions producing intercrystalline cracking are: leakage resulting in concentrating of boiler water, high stress and a water with embrittling characteristics.

Unfortunately, there is no method of chemical analysis which will identify an embrittling water. Such identification must depend on tests made with an embrittlement detector, in which a piece of steel is placed in contact with a boiler water under extreme concentrations and under stress, to reproduce the same conditions which will cause cracking in the boiler. The detector may be installed in the continuous blowdown line of the boiler or at any convenient point.

Several methods of treatment to control embrittlement have been tried. Recently it has been found that whereas small concentrations of nitrate may accelerate embrittlement, larger quantities of nitrate tend to inhibit it. When sodium nitrate is used to counteract embrittlement, a definite nitrate - hydroxide ratio is maintained in the boiler and the best ratio depends on the pressure. The following ratios of sodium nitrate to sodium hydroxide have been recommended: up to 250 psi—0.2; up to 400 psi—0.25; up to 700 psi—0.4.

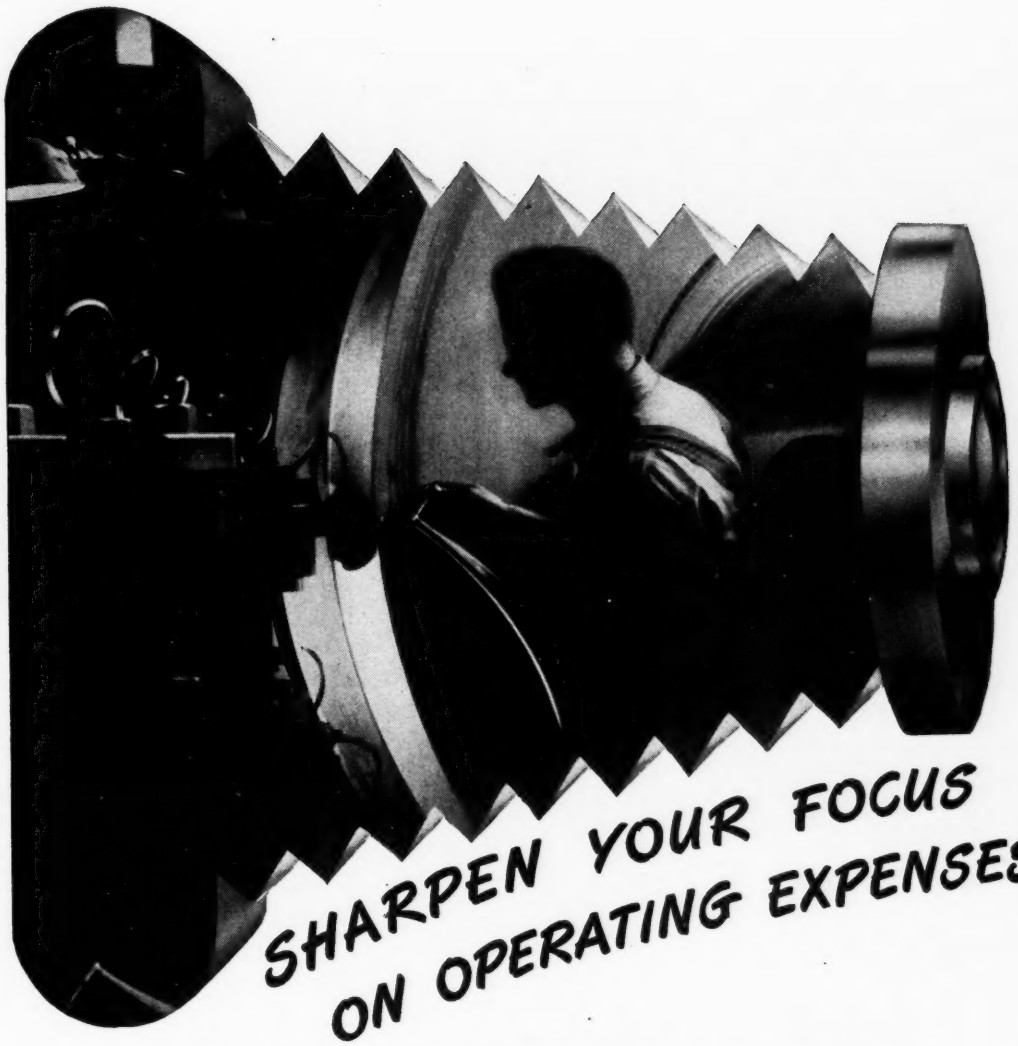
Use of sodium nitrate has proved successful in preventing embrittlement in stationary and locomotive boilers. It may be fed continuously to the boiler feedwater or to the boiler drum. It is stable under boiler conditions and has been successfully employed at pressures as high as 700 psi.

How to Use the Nitrate Comparator

The nitrate content of boiler water can be determined by means of a nitrate comparator which resembles the phosphate comparator shown in Figs. 1 and 2, except that the slide contains standards representing 0, 10, 20, 30, 40, 50, 60, 80 and 100 ppm of nitrate ion (NO_3). Reagents employed are a solution of the alkaloid brucine and concentrated sulfuric acid.

To use the nitrate comparator, place 5 ml of the filtered sample of the boiler water in a small beaker and add 10 drops of the brucine reagent, followed by 10 ml of concentrated sulfuric acid, which must be added and mixed very carefully to avoid spattering. Allow this mixture to stand exactly 5 min and then add 10 ml of distilled water with mixing.

For convenience in handling, this mixture may be cooled by immersing the beaker in cold water, but this is not necessary to insure accuracy. The resulting mixture will have a yellow



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ROTOJET Water-driven Motor Model 321 with short 4-arm head and universal joint for 2½"-3" I.D. curved tubes.

The New
ROTOJET
Water-driven
TUBE CLEANER

Cleans tubes
2½ TIMES FASTER in
a New Jersey power plant

The best previous cleaning time with ordinary water-driven tube cleaners in these boilers with 3" curved tubes ranged from 10 to 20 minutes, depending upon scale conditions. ROTOJET Model 321 reduced the time per tube to 4 minutes. While previous tube cleaners used water pressures of 150-200 psi, ROTOJET established its record on only 100 psi. At 125-150 psi recommended pressure ROTOJET would have done even better.

Considering the time, labor, and water ROTOJET saves, it should repay its entire purchase price the first time you use it. Send for new bulletin.

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color and the depth of color will depend on the nitrate content.

Pour a portion of the yellow mixture into a clean 5-ml test tube and place this tube in the middle hole in the comparator base. Fill two other tubes with clear water and place them in the remaining two holes back of the slots. Compare test portion with the standards by moving the slide in front of it, always reading when one of the arrows on the slide is directly above the arrow on the base. If the color of the sample exactly matches one of the standards, read the nitrate content in parts per million NO_3 (nitrate ion) directly from the values on the slide. If, however, the color lies between two consecutive standards, take the average.

If the concentration of nitrate ion is over 100 ppm, repeat the test on a sample of the boiler water that has been diluted with distilled water. If the sample is diluted with an equal volume of water, multiply the final nitrate reading by 2. The yellow mixture should never be diluted before comparison. The dilution should always be made on the sample of water before adding any reagents.

The procedure is not affected by ions normally present in boiler water. High color, due to tannins, etc., may be overcome by dilution or by removal from the boiler water with decolorizing carbon.

Important: Both reagents used in this determination must be handled with care. Brucine is a poison and concentrated sulfuric acid will attack flesh and clothing rapidly. If the acid comes in contact with the flesh, wash it quickly with cold water and treat it with baking soda.

Control of pH

A knowledge of the technical definition of pH is not essential in applying pH control to boiler room practice. The pH scale may be regarded as a scale of active acidity and alkalinity just as the Fahrenheit thermometer scale is a scale of temperature.

On the pH scale the point of neutrality is pH 7.0; that is, at 7.0 a water is neither acid nor alkaline. Readings below 7.0 indicate an increase in active acidity and the lower the pH value, the greater is the active acidity. Readings above 7.0 indicate an increase in active alkalinity and the higher the pH, the greater is the active alkalinity.

In general, raw waters tend to have pH values in the range 6.0-8.0. Swamp water, acid mine drainage and some well waters with a high carbon dioxide content may be more acid, whereas, water contaminated with alkaline wastes may be above 8.0. Waters with low pH values will corrode metals, whereas, waters with high pH values may precipitate scale in pipe lines, etc.

Clarification of water by means of coagulation depends to a considerable extent on control of pH, each coagu-

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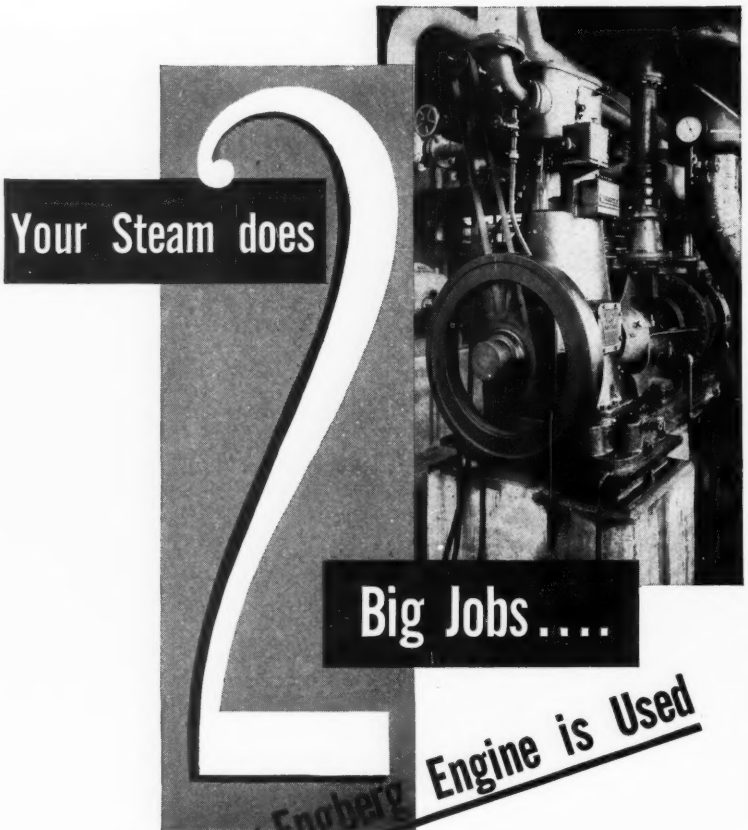

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lant having a pH range over which it functions best. Control of the hot phosphate softening process depends on pH and phosphate content. In silica removal, pH control is an important factor whether the removal is carried out with iron or with magnesium salts. Processes such as iron removal, acid treatment and recirculation of boiler water to prevent corrosion depend, to a considerable extent, on pH. In general, the pH in the boiler water should be not less than 10.5 in order to avoid corrosion and induce proper precipitation of scale-forming salts.

Colorimetric pH Tests are Simple

The simplest method of measuring pH is by colorimetric comparison. Certain dyes, commonly called pH indicators, give different color at different pH values. Each indicator covers a definite range of pH values. For example, bromthymol blue is yellow at pH 6.0 and blue at 7.6. Between these values the dye has various intermediate shades. By using solutions of known pH to each of which is added a definite amount of indicator, color standards can be prepared corresponding to the values pH 6.0, 6.2, 6.4, 6.6, 6.8, 7.0, 7.2, 7.4 and 7.6. Consequently, if the same amount of indicator is added to the sample to be tested, the resulting color can be compared with the color standards and the pH determined.

Indicators are available that cover small intervals over the entire pH scale. For example, cresol red is yellow at pH 7.2 and red at pH 8.8; phthalein red is yellow at pH 8.6 and red at pH 10.2; acyl red is red at pH 10.0 and yellow at pH 11.6, and so on. Color standards such as these can be purchased mounted in plastic slides. A complete outfit, called a pH slide comparator, is relatively inexpensive and very simple to operate.

pH Slide Comparator Like Phosphate Comparator

The pH slide comparator is identical with the phosphate comparator of Figs. 1 and 2. It consists of a base and slide both molded from plastic. The base contains 2 vials of indicator solution with 0.5 ml pipettes, five 5 ml test tubes and a compartment containing an etched glass. Each color standard slide contains 9 standards for any given indicator, alternating with ampoules of water. All slides are marked with the indicator name and pH value. The slide moves in a slot in the base and this slot is fitted with a key to stop the slide at the end standards.

How to Use pH Comparator

To make pH determination, remove the top from the base, remove three test tubes, fill them to the mark (5 ml) with the sample to be tested and repelace them in the holes back of the three slots in the base. To the middle tube, add 0.5 ml of indicator solution by means of the marked

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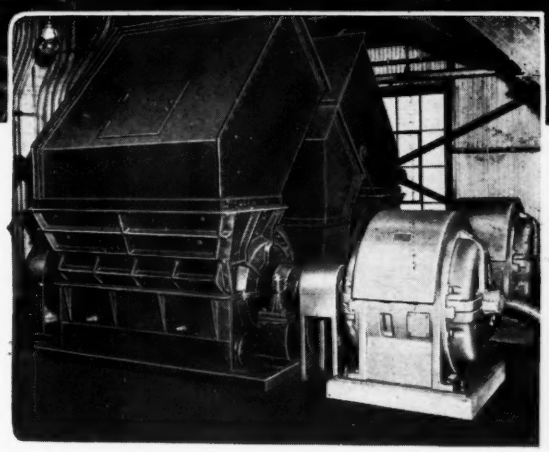

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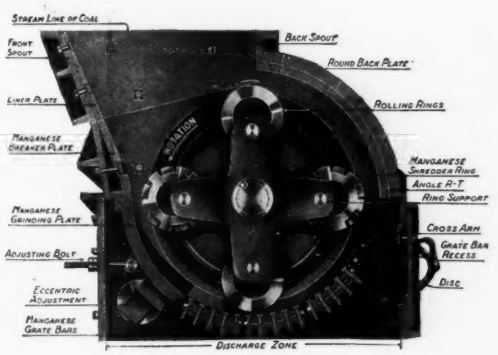
Cross-section showing Americans patented shredder ring action. Each shredder ring revolves on its own shaft and automatically deflects from tramp iron.



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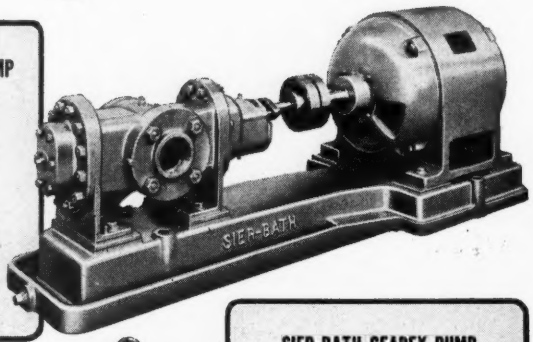

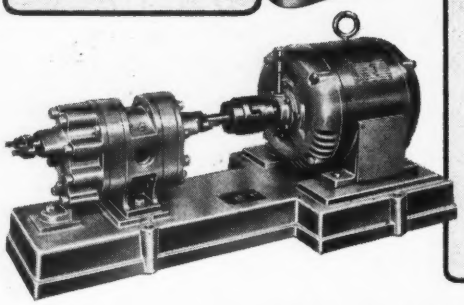

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pipette. Mix the contents of this tube thoroughly. Place the color standard slide on the base and, holding the instrument toward a window or other source of daylight, move the slide in front of the test samples until a match is obtained. Read the pH directly from the values on the slide.

Testing Steam Condensate

Absolutely pure steam condensate should have a pH of 7.0. Too much carbon dioxide will lower the pH and cause corrosion in steam and return lines. When the pH is much above 7.0, entrainment of boiler water containing alkalinity may be indicated, but the presence of ammonia, due to the decomposition of nitrogenous matter in the boiler, may also be indicated. Steam condensate, encountered in practice, may vary considerably from the ideal value. High carbon dioxide content may reduce the pH to as low as 5.0, whereas entrainment and ammonia may raise the pH to 9.0. In general, values from pH 6.5 to 7.5 should be maintained. Solids in the steam are undesirable due to their action on turbine blades, steam cylinders, valves, traps, etc. When live steam is used in process, contamination of the product may result.

Solutions containing mixtures of certain salts tend to resist change in pH and are classified as buffered samples. Such materials do not require extraordinary care in testing the pH. However, steam condensate is practically free from dissolved salts and is therefore unbuffered.

Consequently, a special procedure for determining the pH should be followed in order to secure accurate results. Errors in the regular methods of detemining pH are usually due to gain or loss in carbon dioxide or other volatile constituents and to the effect of the indicator solution. By carrying out the test in a deep tube and by using a very small amount of indicator, these factors can be eliminated. Sufficient color is obtained by observing a deep layer of sample using the water analyzer illustrated in Fig. 3.

How to Test Condensate for pH

Fill two water analyzer tubes exactly to the mark with the water to be tested and place them in the outside compartments. Rinse the third, marked "pH," with the water to be tested. With a special pipette, put exactly 0.18 ml of indicator solution in the tube. With a second pipette, measure exactly 27 ml of the water to be tested into this tube, placing the tip of the pipette on the bottom of the tube to minimize exposure of the sample to the air. Mix indicator and samples by stirring with the tip of the pipette. NEVER mix the contents by inverting the tube and covering the open end with the hand.

With the large pipette, remove ex-

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cess sample until the meniscus is even with the line on the tube. Then place the tube in the middle compartment and compare it with the proper pH color standard slide in the manner described for the determination of silica.

Conductance Method for Soluble Solids in Condensate

The soluble solids content of condensed steam is frequently determined by a conductance method of analysis. Electrolytic solids and ionizable gases in condensed steam have the ability to conduct electricity. This property makes it possible to detect these materials in solution by means of a special conductance cell which can be calibrated against known samples. However, when any appreciable quantity of ammonia or free carbon dioxide is present in the steam, it is necessary to determine the concentrations of these gases and make suitable corrections. Ammonia can be determined at very low concentrations by means of the water analyzer using tubes with a sample depth of 250 mm. A 50 ml sample of condensate is mixed with 1 ml of Nessler reagent and transferred to a long form water analyzer tube, filling it to the 250 mm mark. The tube is allowed to stand 10 min after the addition of the reagent and is then compared with the ammonia standards as in the determination of silica.

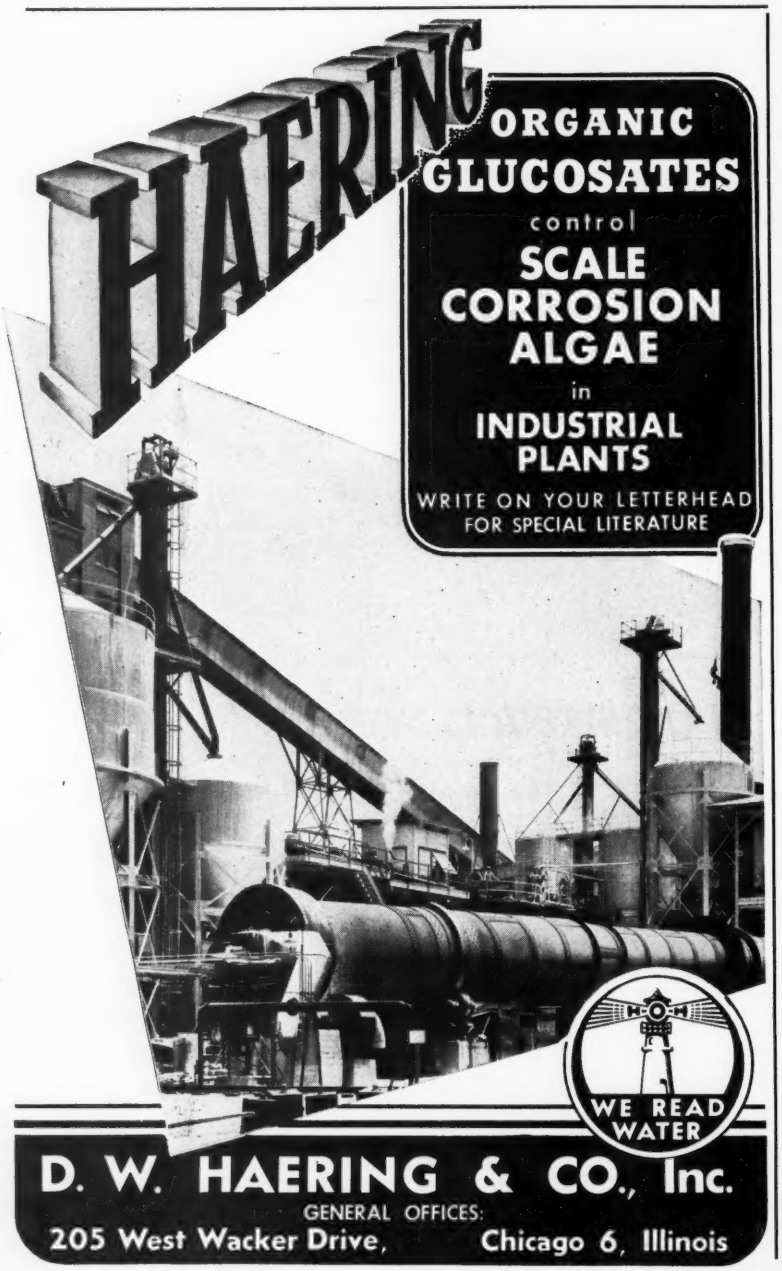
Testing for Polyphosphates

Special phosphates such as tetra sodium pyrophosphate, sodium metaphosphate and substances of intermediate composition have the property of forming slightly ionized or soluble complexes with calcium. Such phosphates when added to feedwater inhibit scale formation in the feed lines. When they reach the boiler, they revert to orthophosphate, reducing excess alkalinity and forming a sludge in the boiler water.

This property of forming soluble complexes of phosphate and metal is useful in many fields such as municipal and process water treatment, textile processes, detergent processes, etc. The polyphosphates can be converted to orthophosphate by boiling an acidified sample and determined as such.

The polyphosphates in small concentrations (threshold treatment) tend to minimize corrosion and prevent red water. Such low concentrations can be determined by means of a polyphosphate comparator covering the range 0 to 10 ppm. The method employed enables one to determine both ortho and polyphosphate over this range.

The operation of the polyphosphate comparator is based on the fact that polyphosphates are changed to orthophosphate when boiled with a conversion agent (Reagent A). The orthophosphate reacts with the Reagent B to form phosphomolybdic acid which is then reduced with diluted Reagent C to give a blue color, the intensity of which is proportional to the concentration of phosphate present. Complete detailed instructions for this test will be given in a subsequent issue.



ATOMICS

(Continued from page 73)

nucleus are balanced by the two electrons revolving around it.

The hydrogen atom, however, would like another electron in the orbit surrounding the nucleus. Therefore, it tends to combine with another hydrogen atom somewhat as shown in Fig 3b so that each electron partially satisfies the deficiency of each orbit. This locks the two atoms together to form the hydrogen molecule.

The quantitative treatment of the problem, taking into consideration the Coulomb, the electromagnetic, gravitational and exchanges forces, indicates that at relatively great distances the two atoms attract one another and that, as the separation decreases, the attractive force diminishes until finally, at certain distances of

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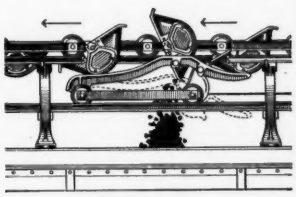
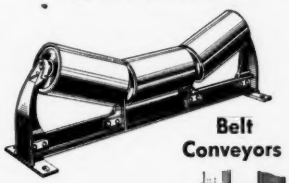
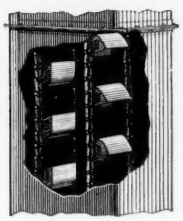


Bucket Carriers



Belt Conveyors



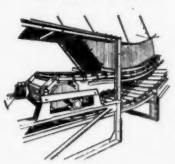
Bucket Elevators

Bulk-Flo

Screw Conveyor

Skip Hoist

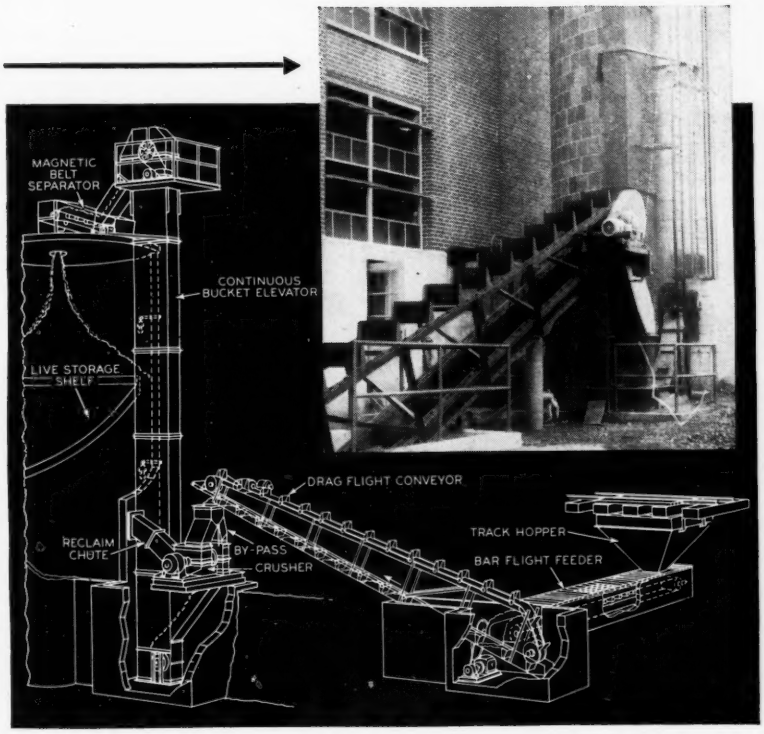
Coal Crusher



Feeders

Car Dumper

Weigh Larry



Flight Conveyor-Crusher-Bucket Elevator System Simplifies Coal Handling at Pepperell

Another example of the effectiveness of a Link-Belt integrated system of standardized units is afforded by the coal handling layout at Pepperell Mfg. Co. at Opelika, Alabama.

As illustrated by the diagram and photo above, the operation is as follows: coal from track hopper is delivered by bar flight feeder to drag flight conveyor that empties into chute of coal crusher. The crushed coal is elevated to top of silo by a continuous bucket elevator, discharging to belt conveyor with magnetic pulley, that delivers the crushed coal to live storage part of silo. From live storage, coal is chuted to scales and pulverizer (inside plant). A by-pass chute from drag flight conveyor permits sized coal to by-pass the crusher. A chute from the dead storage section is provided to reclaim coal from this part of the silo.

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COAL AND ASHES HANDLING EQUIPMENT

11,005

separation, the force becomes zero. For a still shorter distance, the force becomes a repulsion. Where the force becomes zero, the distance between the two atoms is that which should exist in the hydrogen molecule. In fact, the quantitative prediction of the theory gives with great accuracy the normal interatomic distance in the hydrogen molecule, and also the heat of dissociation of the hydrogen molecule.

The Meson Theory

Some thirteen years ago a Japanese physicist, H. Yukawa[1] proposed a similar theory to account for the forces that hold the component particles together. Yukawa assumed that a proton can emit a positively charged particle, thereby becoming a neutron,

[1]Proceedings of Physico-Math Soc. Japan. 17, 48, 1935.

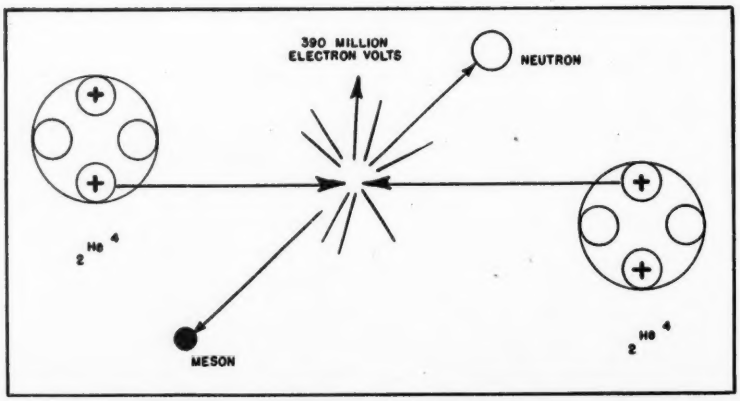

Fig. 4. When two high energy protons meet head-on, one of the protons is converted into a neutron and a negative meson

while a neutron can emit a negatively charged particle, thereby becoming a proton.

When two protons approach each other they may exchange these emitted particles in the same manner as when two hydrogen atoms approach each other they exchange orbital electrons. This process would give rise to an exchange force, which, when combined with the Coulomb, the electromagnetic, and gravitational fields, would produce a combined field of the same character as that in the hydrogen molecule.

The same action can be assumed to take place between two neutrons or between a proton and a neutron. In the latter case, as a consequence of the interchange of the charged particles, each becomes alternately a proton and a neutron in rapid succession.

Yukawa described the interchange of these charged particles in terms of quanta, called *mesons*. Moving charges—those we have been familiar with in the past—produce radiation fields which can be quantized and described in terms of protons. Yukawa assumed the "quanta" surrounding a nuclear particle to be a meson. In initiating this theory he suggested that if the mesons are given a finite rest mass m, the range of force arising from the meson field will be h/mc, the Compton wave length for the meson.[2] If the range of nuclear forces is assumed to be 2.8×10^{-13} cm, the meson *rest* mass should be about 140 electron masses. Where these mesons are emitted from protons or neutron in the manner described their mass should be about 180 times the rest mass of the electron.

About two years after Yukawa proposed the meson theory, mesons were actually discovered as a consequence of cosmic ray activity, by Dr. Carl Anderson of the California

[2]For an explanation of the Compton effect, see Encyclopedia Britannica, 14 Ed. Volume 6, page 187.

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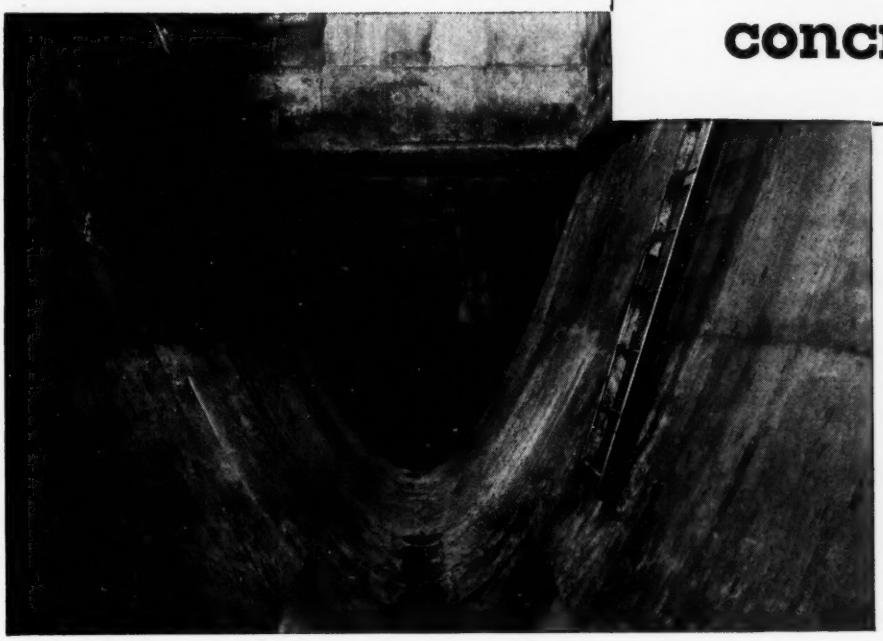

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Institute of Technology. At the time he called it the mesotron. Today, the name meson is more generally used though meson and mesotron are still used interchangeably.

Anderson's meson was found to have a mass of about 200 times that of the electron and had either a positive or a negative electric charge. The discovery of these particles in cloud chamber observations was regarded as a brilliant confirmation of the Yukawa theory but they were observed only in cosmic ray activity. No effort to produce them as a result of bombardment by particles accelerated in cyclotrons or other man made accelerators was ever successful. Only the cosmic ray had sufficient energy to create them, that is, until recently.

Just about two months ago they were produced for the first time at the Radiation Laboratory at the University of California as a part of the research being carried on for the Atomic Energy Commission.

It had long been realized that when cyclotrons of sufficient power were built that the meson could be produced. When Yukawa proposed the meson theory it appeared, at the time, to be very much of an *an hoc* hypothesis but the subsequent discovery of the particle in cosmic ray radiation by Anderson and others gave a great deal of acceptance to this explanation of nuclear forces. It requires an energy of at least 100 million electron volts to separate a meson from a nucleus and until accelerating equipment of this power was available there was no chance of producing mesons artificially, that is in the laboratory.

Mesons Produced in 184-in Cyclotron

With the completion of the new 184-in. cyclotron at the University of California, such energies have become available and, as was predicted observations of meson tracks were made for the first time on Saturday night, February 21. Tracks of the mesons have been observed on photographic emulsion plates placed adjacent to targets of carbon, beryllium and other materials against which the great cyclotron hurls 280 million electron-volt alpha particles.

This development opens up unprecedented opportunities for further investigation into sub-nuclear processes. As Professor E. O. Lawrence, said in announcing the discovery, the meson is the best tool ever obtained for examining the internal forces of the nucleus of the atom. This development will enable scientists to study, more or less on their own terms, the critical nuclear process in which the meson is involved.

The research leading to this discovery was done by Dr. Eugene Gardner, research physicist of the Radiation Laboratory and Dr. C. M. G. Lattes, a Brazilian scientist from the University of Sao Paulo.

Dr. Gardner who received his doctorate at Berkeley and worked on the Manhattan Project at Oak Ridge, has been bombarding photo-

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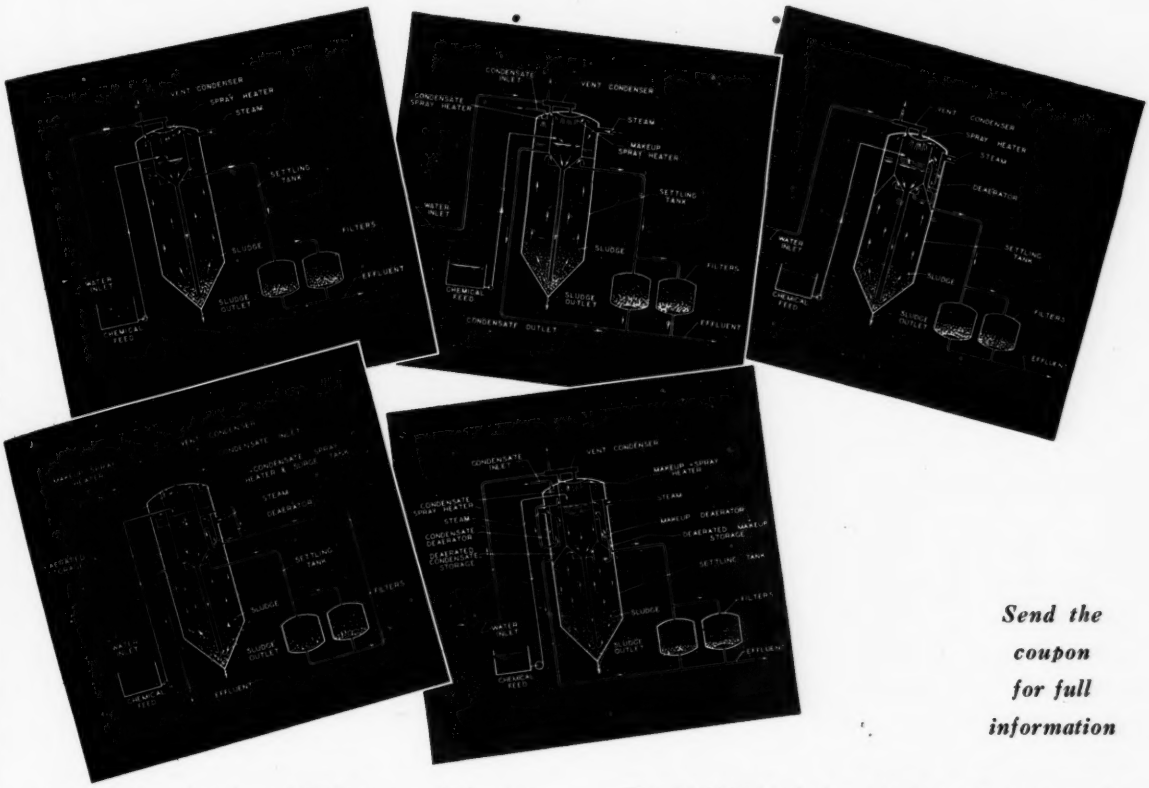

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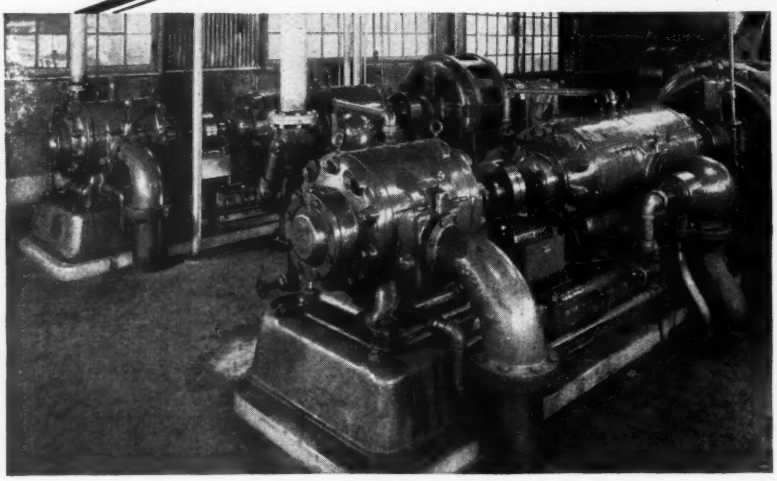

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graphic emulsions in the cyclotron for over a year in studies of various atomic disintegrations. He developed methods of working with emulsions in the great machine.

Dr. Lattes for the past two years has been working with a group of scientists at the University of Bristol in England. Dr. Lattes, Dr. C. F. Powell and Dr. G. P. S. Ochialini, working at Bristol, have led in the application of specialized techniques for studying cosmic ray action by means of photographic emulsions. These three men made notable progress in basic knowledge of the meson in their work at Bristol. Before the Bristol findings were revealed, it was generally believed that only one kind of meson existed. This was the meson suggested by Yukawa, one having a mass approximately 180 - 200 times the mass of the electron. Found at sea level, this meson has a life of two millionths of a second and energies up to billions of electron volts. It is a secondary cosmic ray particle, and scientists considered it to be made as a result of the bombardment by heavy, energetic, primary rays entering the earth's atmosphere from outer space and colliding with nuclei of the atmosphere.

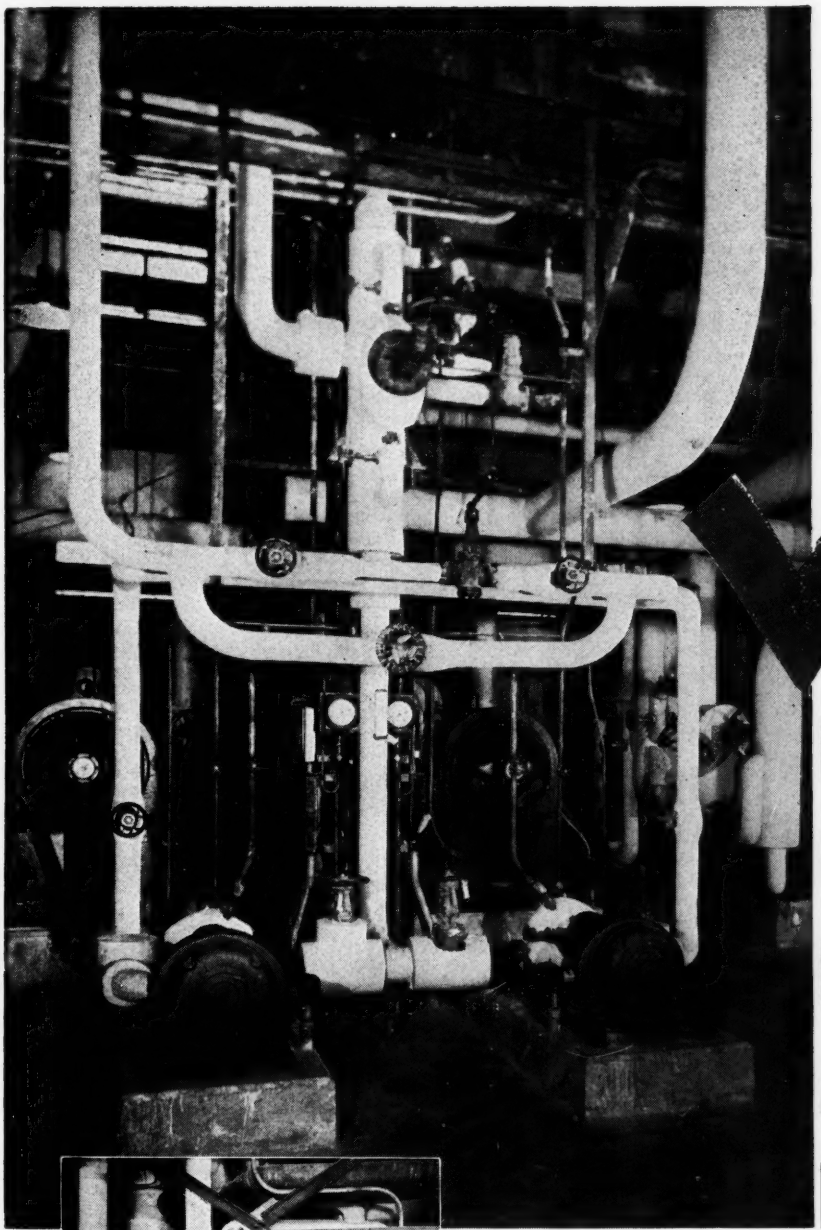
In attempting to fit the idea of this type of meson into nuclear theory one great difficulty lay in the fact that this meson did not interact with atomic nuclei, its birth could not be explained adequately and its brief life was climaxed by oblivion. It was obvious, however, that these *light* mesons were products of nuclear particle collisions.

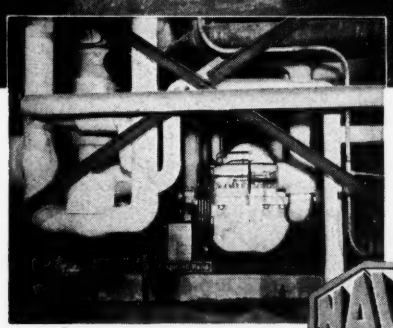
During years of careful study and development of special techniques, the scientists at Bristol, taking their emulsions to mountain tops in the Andes and Pyrenees, were able to explain how the light mesons originated from a *heavier* meson.

The Bristol scientists found on their photographic emulsions mesons of a mass about 320 times that of the electron. They found that these heavy mesons were both positively and negatively charged, and there was some evidence that a neutral meson also existed.

All of these heavy mesons were studied at very low energies, of a few million electron volts, when they were close to or undergoing disintegration. At these energies, the positively charged heavy mesons, being unable to penetrate the electrical barriers of positively charged nuclei, simply wandered through the photographic emulsion until they disintegrated, giving birth to light mesons.

However, the negatively charged heavy mesons were greedily swallowed by nuclei, resulting in the detonation of the capturing nuclei into showers of particles called "stars". At the end of their course, when nearing capture, the mesons made a wavy track. This track is made because the particle is relatively light, and, at the extremely low energies involved, it





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takes a severe buffeting from nuclei in the emulsion. Thus, the Bristol experiments explained where the light mesons originated and why they were unable to interact with nuclei. The negative heavy mesons, now known as a result of the Berkeley research to have a mass of 313, are the types which have been produced in the giant Berkeley cyclotron. The characteristic wavy track and the "stars" resulting from detonation of nuclei are also observed. About half the meson tracks observed, end in stars.

The mesons are the result of a rather intricate sub-nuclear process which can occur at the peak energy of the large cyclotron only a small percentage of the time in a number of collisions. As is well known, an alpha particle is composed of four particles—2 neutrons and 2 protons. On the average, each of these four particles has one-fourth of the 380 million electron volts which the cyclotron gives to the alpha particle. This equal division of energy is just an average over a given period of time however. At times, one or more of the particles will have more than its proportionate share of the available energy. Sometimes when an alpha particle crashes into the target, one of the protons or one of the neutrons has a great deal more than its average one-fourth share of the total 380 million electron volts. A small percentage of the time one particle will have as much as 225 million electron volts.

The particles in the target nuclei are actually always in motion inside these nuclei. If a proton in a target nucleus happens to be moving towards a bombarding 225 million electron volt proton in the alpha particle at the time of collision, there is a compounding of energy, the total of which is about 390 million electron volts, just sufficient for the release of mesons.

When two such protrons meet head-on, one of the protons is converted, by nuclear exchange forces operating at the time of collision, into a neutron and a negative meson. The observed mesons have an energy of only about four million volts, an extremely low energy for a meson. The mesons travel about nine inches in a vacuum between their origin in the target and their destination in the photographic emulsion.

The emulsions are about two-thousanths of an inch thick. They are very much like those of ordinary fine-grained photographic plates but considerably thicker. Stacks of about six emulsions are placed edgewise to the path of the mesons for 10 minutes. The mesons make tracks about four one-hundredths of an inch long, the track being made by electrons knocked off nuclei in the emulsions. The scientists place the developed emulsions under a 600 power microscope in order to bring the tracks into view.

Theoretical calculations indicated

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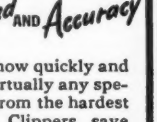

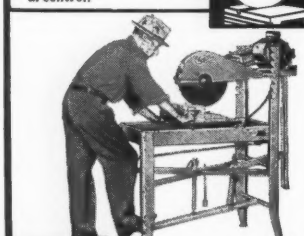

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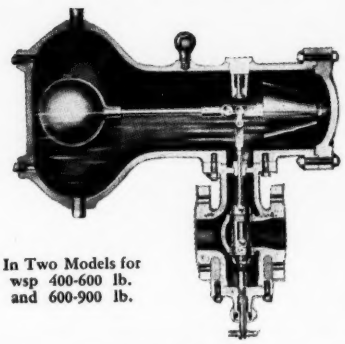

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that mesons were being made from the beginning of the operation of the big cyclotron over a year ago. Since barely enough energy was available, however, and the percentage of meson producing hits was so small, it was considered a strong possibility that mesons might not be observed at all until an even more powerful accelerator was built. The compounding of techniques developed by Drs. Gardner and Lattes permitted the observation of meson tracks on the first plates exposed in the cyclotron bombardments.

The production of these mesons in the California cyclotron will greatly accelerate research in this field of nuclear physics. In the British experiments, using cosmic rays as the source of energy, it took eight people working a year to get 100 negative meson tracks. At the University of California, one person has observed 27 tracks in ten minutes of observation.

The discovery of these meson tracks is of inestimable significance to scientists. It proves that the idea is right; that there is an intimate connection between nuclear particles and mesons and between nuclear forces and mesons. With the means now provided to create and observe mesons under controlled laboratory conditions, it may be possible to determine what are the ultimate particles of matter, why only these particles exist and what their properties are. As Dr. Serber pointed out, it is now a simple matter to determine the masses of the mesons, previously a matter of uncertainty. Also, further study of the meson will be of particular importance in determining the nature of the subatomic force which holds nuclei together a force unlike any other known to man.

AMPLIDYNE

(Continued from page 64)

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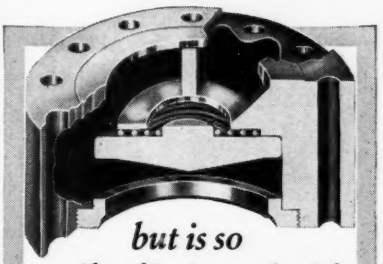

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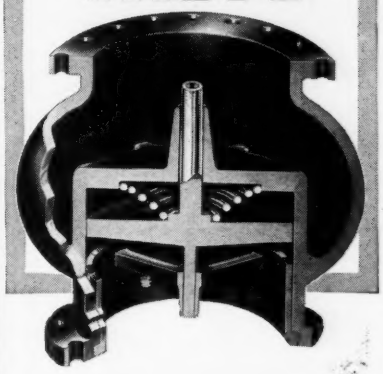

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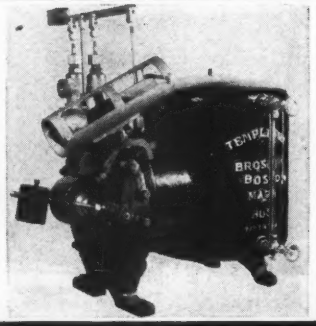

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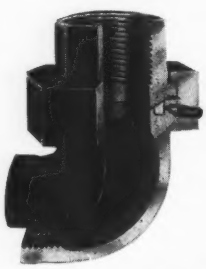

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bination as this have opened up an entire new era in the industrial world. Manufacturing processes are constantly being made faster and more accurate.

Amplidyne Diagram Practice

Figure 8 shows the diagram symbol usually used for the amplidyne. The terminal markings on an amplidyne have fixed and definite meanings. In order to readily read and understand diagrams employing amplidyne symbols, knowledge of this convention is necessary. The convention is simple, i.e., current flowing in a control field from the lower to the higher numbered subscript produces flux in a direction which tends to make the armature A2 terminal positive. Thus, current flowing from F1 to F2 will tend to make A2 positive. And conversely, current flowing from F 8to F7 would tend to make A1 positive. Notice that care is exercised to use the expression "tend to make positive" because the actual polarity of the amplidyne will depend upon the net ampere turns resulting from the action of all the control fields combined.

It is interesting to note that the amplidyne convention as stated in the previous paragraph makes no mention whatsoever of direction of rotation. This could not be done with a conventional d-c generator, but with the standard amplidyne it is quite proper. If the direction of rotation of an amplidyne is reversed the direction of the short-circuit flux is also reversed. Inasmuch as the short-circuit flux produces the load voltage, the effective result on the load voltage is the same as would be obtained in a conventional d-c generator if both the direction of rotation and of the field curent were reversed.

The arrows used with amplidyne control fields serve a dual purpose. First, an arrow indicates the normal direction of current flow through the field with which it is associated. Second, the arrow points toward the amplidyne armature terminal which is made positive because of the excitation of that one field if it were acting alone.

Part II of this article will be devoted to a typical amplidyne application. The application which has been selected for this discussion is a Ward Leonard, or adjustable voltage, system for speed control of a d-c motor.

BIBLIOGRAPHY

1. Alexanderson, E. F. W., M. A. Edwards, K. K. Bowman; The Amplidyne Generator — Dynamoelectric Amplifier for Power Control; General Electric Review, Vol. 43, No. 3, pp. 104-106; Mar., 1940.
2. Alexanderson, E. F. W., M. A. Edwards, K. K. Bowman; The Amplidyne System of Control; Proc. I.R.E., Vol. 32, No. 9, pp. 513-520; Sept., 1944.
3. Fisher, Alex; Design Characteristics of Amplidyne Generators; General Electric Review, Vol. 43, No. 3. pp. 107-113; Mar., 1940.
4. Graybeal, T. D.; Steady-State Theory of the Amplidyne Generator; A.I.E.E. Trans., Vol. 61, No. 10, pp. 750-756; Oct., 1942.

Mohler, F.; The Amplidyne — A New Tool of Many Uses; Iron and Steel Engineer, Vol. 17, No. 9, pp. 49-57; Sept., 1940.

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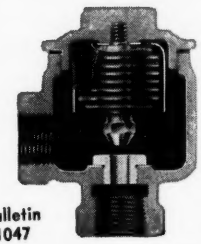

Bulletin 1047

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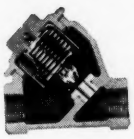
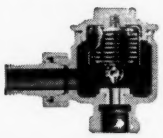
Two reasons why Nicholson thermostatic traps prove superior in test after test: (1) operate on lowest temperature differential, 5° to 15°, depending on trap size and steam pressure. (2) 2 to 6 times average drainage capacity. We'll gladly send one for testing.



5 TYPES FOR EVERY APPLICATION—power, heat, process; size 1/4" to 2"; pressure to 225 lbs. Bull. 1047 or see Sweet's.



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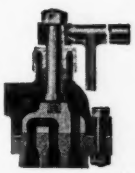

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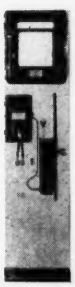

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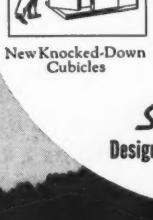

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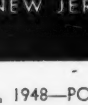

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POWER PLANT *Construction News*

Calif., Ukiah—Masonite Corp., 111 West Washington St., Chicago, Ill., wood fiber insulation board, plans power plant at proposed new mill in vicinity of Ukiah. Several one-story buildings will be erected for processing and general production. Entire project reported to cost close to $2,500,000, with machinery.

Conn., Milford—Connecticut Light & Power Co., Hartford, Conn., has plans for expansion in Devon generating station, Milford, and will begin work on steel frame superstructure at early date. Installation will include turbine-generator, high-pressure boilers and auxiliary equipment. No estimate of cost announced. United Engineers & Constructors, Inc., 1401 Arch St., Philadelphia, Pa., is consulting engineer, and will supervise erection.

Ill., Geneva—State Dept. of Public Works & Buildings, Springfield, Ill., has plans maturing for new power plant at State Training School for Girls, Geneva, estimated to cost about $500,000. LeLelw Cather & Co., 20 North Wacker Drive, Chicago, Ill., are engineers.

Ind., Lawrenceburg—Indiana & Michigan Electric Co., South Bend, Ind., has plans under way for new steam-electric power plant near Lawrenceburg, where site has been secured with frontage on Ohio River. Installation will include two turbine-generators, high-pressure boilers and auxiliary equipment, with total cost approximating $20,000,000, including transmission lines. It is proposed to begin work early in 1949.

Ind., Marion—Dept. of Public Works, City Hall, plans electrification of pumping station used for municipal water system, including installation of additional equipment and complete modernization of plant facilities. Consoer, Townsend & Associates, 351 East Ohio St., Chicago, Ill., are consulting engineers.

Ky., Louisville—Louisville Gas & Electric Co., Louisville, has plans maturing for extensions in Paddy's Run steam-electric power plant, to include installation of 2 new 60,000-kw turbine-generator units, high-pressure boilers and accessory apparatus. No estimate of cost announced. This is part of an expansion program authorized by company to cost approximately $26,000,000.

La., New Orleans—Louisiana Power & Light Co., New Orleans, has authorized an expansion and improvement program to cost approximately $18,000,000. Work will include extensions in generating station, with installation of new 60,000-kw turbine-generator, boiler and auxiliary equipment. Last noted work will be placed under way soon. New transmission and distribution lines will be constructed, as well as power substation facilities.

Mich., Crystal Falls—Wisconsin-Michigan Power Co., Appleton, Wis., plans expansion in hydroelectric generating station on Michigamme River, near Crystal Falls, including installation of new generator unit and auxiliary equipment. Mead & Hunt, 550 State St., Madison, Wis., are consulting engineers.

Mich., Detroit—Detroit Edison Co., 2000 2nd Ave., is arranging an appropriation of approximately $60,000,000 for extensions and improvements in power plants and system during 1948 and 1949, including expansion in generating facilities, power substations, transmission and distribution lines. Two new sites have been purchased for proposed power plants at later date, not included in fund noted, one in vicinity of present generating station on Connor Ave., fronting on Detroit River, and other on St. Clair River, vicinity of Maryville, Mich.

Mich., Manistee—American Pulp & Paper Co., Manistee, plans expansion and improvements in power plant at mill, with installation of equipment for increased capacity. This is part of a general expansion program at mill, entire project estimated to cost about $4,000,000. Company is a subsidiary of American Box Board Co., Grand Rapids, Mich.

Minn., Minneapolis—Northern States Power Co., 15 S. 5th St., has taken out permit for new addition to Riverside generating station, 29th St. and Marshall Ave., N.E., and work will be carried out at once. Additional equipment will be installed. Cost reported over $1,000,000.

Miss., Gulfport—Mississippi Power Co., has authorized an expansion and improvement program in properties to be carried out over period of 24 months, with cost esti-

mated at $9,100,000. Work will include generating station, power substations, transmission and distribution lines.

Mo., Columbia—City Council plans extensions and improvements in municipal steam-electric generating station with installation of equipment for increased capacity, including coal-handling apparatus. Bond issue of $500,000 has been arranged for this and enlargements and betterments in waterworks station. Burns & McDonnel Engineering Co., Bannister Rd. and Troost St., Kansas City Mo., is consulting engineer.

Mo., Jefferson City—State Prison Board, Jefferson City plans new power plant at local State Penitentary, estimated to cost about $500,000, with boilers, generator and auxiliary equipment. Application has been made to Missouri General Assembly for appropriation in amount noted.

Neb., Lincoln—State Board of Control, Lincoln, plans extensions and improvements in power plant at local State Penitentary, including installation of new generating unit and auxiliary equipment. Cost reported about $150,000.

N. Y., Niagara Falls—Niagara Falls Power Co., a unit of Niagara Hudson Power Corp., Buffalo, N. Y., plans large expansion in Schoellkopf hydroelectric generating station, including installation of five new hydraulic turbines and electric generators with rating of 37,500-kw. Work is expected to be placed under way in near future.

N. C., Wilson—City Commission plans expansion and improvements in steam-operated municipal power plant and electrical distribution system. Additional equipment will be installed. Entire project is estimated to cost about $1,500,000. Bond issue in that amount has been arranged.

Ohio, Cincinnati—Cincinnati Gas & Electric Co., 4th and Main Sts., has tentative plans in progress for new steam-electric power plant on large tract of land in Coney Island district, fronting on Ohio River. Installation will include two large turbine-generators, high-pressure boilers and auxiliary equipment. Entire project is estimated to cost approximately $20,000,000, including transmission and distribution lines.

Ohio, Dayton—Water Department, City Hall, has plans nearing completion for new water-softening plant on Ottawa St., for municipal water system, vicinity of Mad River. Cost estimated about $2,000,000. Proposed to ask bids in June.

Okla., Ponca City—Oklahoma Gas & Electric Co., Oklahoma City, Okla., plans expansion in Lincoln Beerbower steam-electric generating station, Ponca City, with installation of new turbine-generator, high-pressure boiler and auxiliary equipment. Cost estimated about $3,600,000. Work is scheduled to begin soon.

Pa., Pittsburgh—West Penn Power Co., West Penn Bldg., will expend about $14,000,000 during present year for construction and equipment installation for new Mitchell steam-electric generating plant, on which work was begun last year. Station is scheduled for completion in 1949, and will represent a total investment of about $24,500,000, including switching station, transmission lines and auxiliary operating facilities.

S. C., Clemson—Board of Directors, Clemson College, will build a new steam-generating plant at institution, instead of making extensions in present boiler house, as recently noted in these columns, with cost estimated at close to $500,000. It will be used for central-heating service. J. E. Sirrine & Co., 215 South Main St., Greenville, S. C., are consulting engineers.

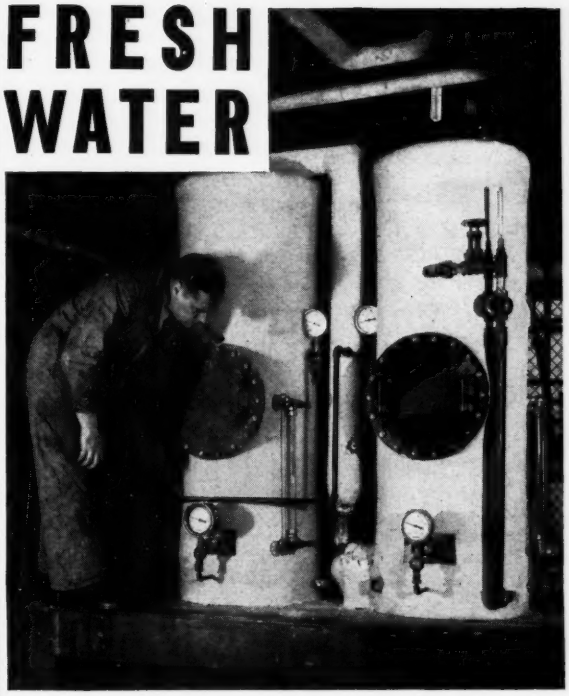
S. C., Piedmont—Duke Power Co., Charlotte, N. C., is reported planning two new steam-electric generating stations in vicinity of Piedmont, to be carried out in conjunction with an expansion and improvement program over period of number of months. Each will be equipped for a capacity of about 65,000-kw. Entire project is estimated to cost approximately $20,000,000, with power substations, transmission lines and other facilities.

Wash., Seattle—Board of Regents, University of Washington, has plans for new boiler house for central-heating service at institution. No estimate of cost announced. Proposed to carry out work soon. John Paul Jones & Leonard Bindon, Hoge Bldg., are architects; Lincoln Bouillon, Fourth Ave. Bldg., is consulting engineer, both Seattle.

Wis., Black River Falls—Municipal Electric & Water Utilities plans expansion in hydroelectric generating station, including installation of two new 600-kw generator units. A new power house will be built. Mead & Hunt, 550 State St., Madison, Wis., are consulting engineers.

Wis., Madison—Oscar Mayer & Co., 910 Mayer Ave., meat packer, has approved plans for new boiler house at plant, reported to cost over $85,000, and work will be placed under way soon.

FRESH WATER



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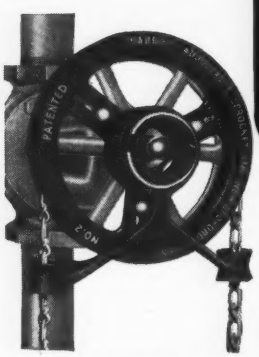

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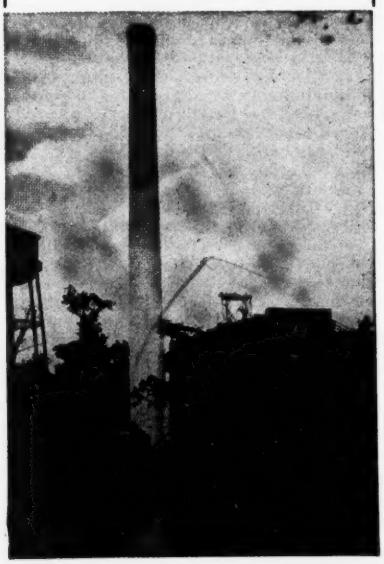

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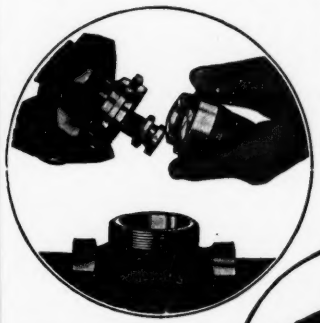

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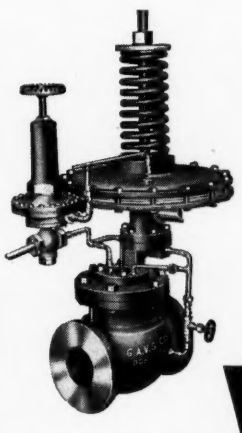

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writes user of NATIONAL GIRTH SEAM PROTECTOR

We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.

Von Platen-Fox Co.
Iron Mountain, Mich.

You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

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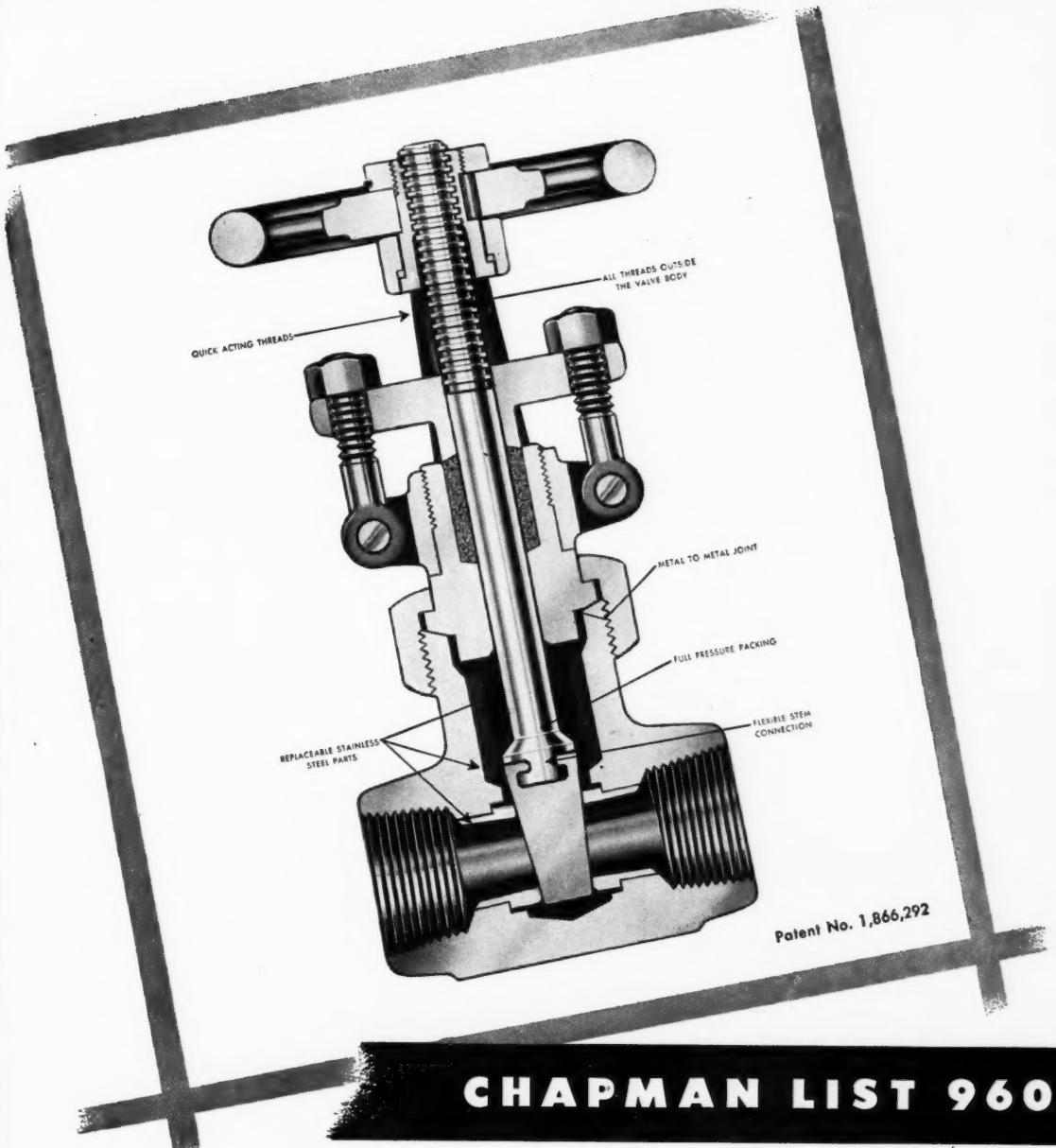

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A Small Gate Valve That Will Stay on the Job

Here is a compact forged steel gate valve so ruggedly built that it practically eliminates the maintenance and replacement problem. Because no pressure is transmitted to the stem, it can be repacked under full pressure. Its quick-acting threads will not stick or freeze. It is supplied with super-hardened seats and plugs for extra severe services.

Made in sizes from ¼" to 2"— carbon steel for pressures to 800 pounds; alloy steels for pressures to 1000 pounds at 750° F. For higher pressures, specify List 990.

The Chapman Valve Manufacturing Company
INDIAN ORCHARD, MASSACHUSETTS

Soft water... lower Silica content

—less load on filters—

WITH THE PERMUTIT SLUDGE BLANKET HOT PROCESS

Permutit has successfully applied the "Sludge Blanket Design" to the hot process method of softening water! Advantages? They are many: (1) MORE SILICA is removed from water than with previous types of equipment for the same amount of reagent fed, (2) LOWER TURBIDITY eases the load on filters . . . makes for better filter operation, (3) MORE COMPLETE REACTION greatly increases the degree of softening, (4) SAVINGS ARE SUBSTANTIAL on operating costs by reducing the amount of chemicals (phosphate and lime) required for softening.

For full details on the operation of this new Permutit Sludge Blanket Hot Process, write to The Permutit Company, Dept. PG-5 330 West 42nd Street, New York 18, N. Y., or to the Permutit Company of Canada, Ltd., Montreal.

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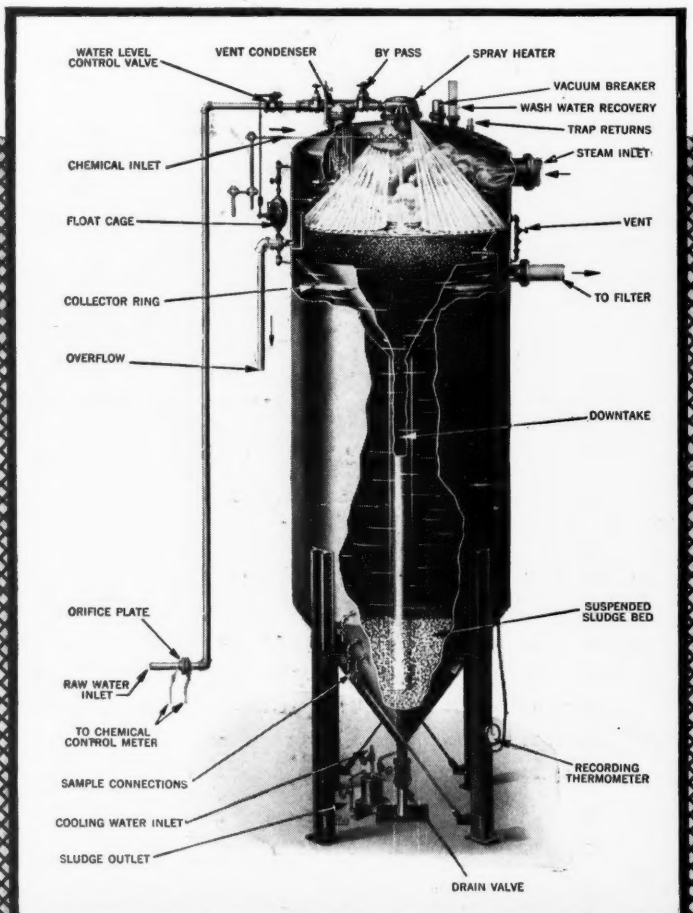
• *FOR 35 YEARS WATER CONDITIONING HEADQUARTERS*



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INCLUDING Power Plant ENGINEERING ESTABLISHED 1896

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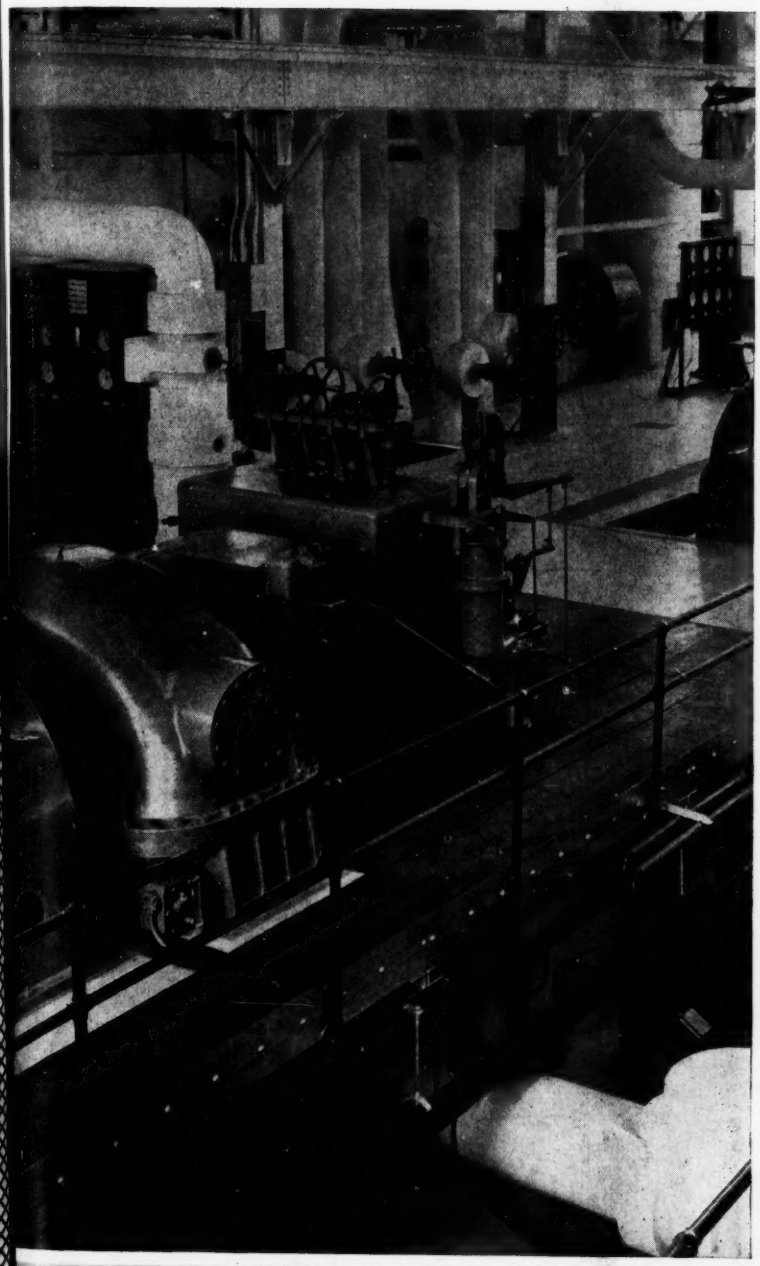

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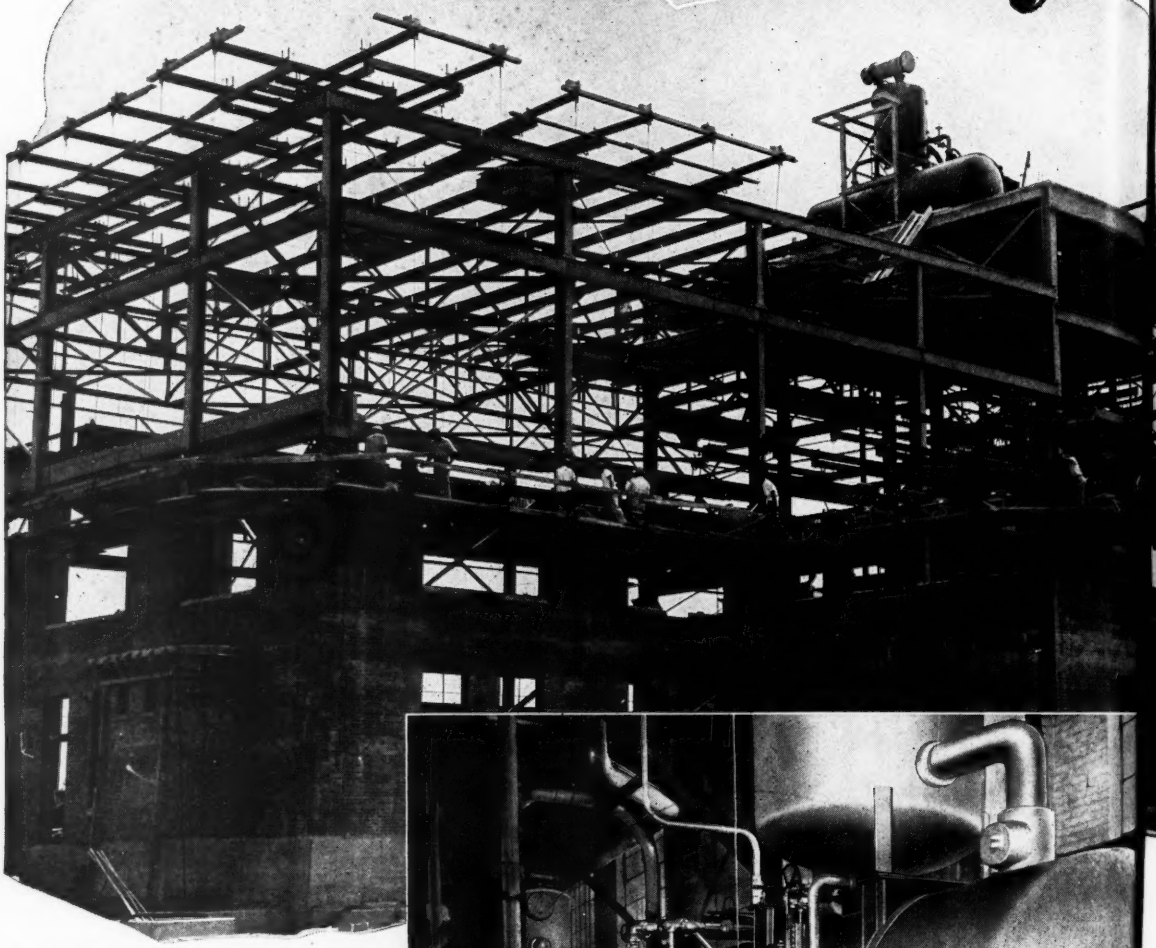
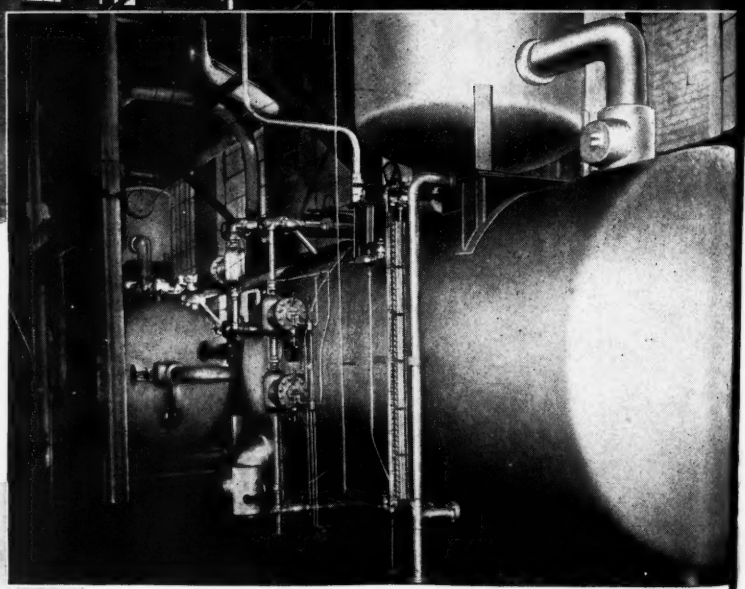
COVER: ONE OF TWO 6000-KW. STEAM TURBINE GENERATORS IN POWER STATION OF SOUTHLAND PAPER CO. AT LUFKIN, TEXAS. (General Electric photo).

Magazine That Helps Men Responsible for Generation of Steam, Electricity and All Other Forms of Power Supply

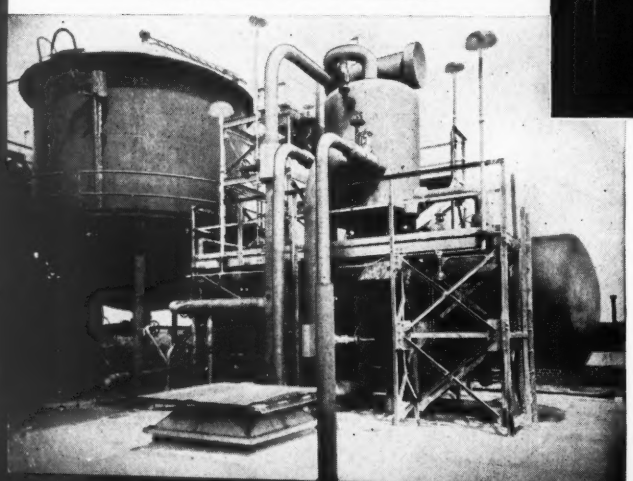
Wherever industry



One of the first pieces of equipment installed, an Elliott 225,000-lb-per-hr deaerating feedwater heater shows against the skyline of Plant Hagood, South Carolina Power Company. An Elliott evaporator preheater and closed heater are also used.



One of three Elliott 225,000-lb-per-hr deaerating heaters (two installed) at Plant Eaton, of Mississippi Power Co. Here too Elliott evaporator preheaters and closed heaters are also installed.



Two of the four 400,000-lb-per-hr Elliott deaerating feedwater heaters in Plant Arkwright of Georgia Power Co. Elliott evaporator preheaters used here, too.

Elliott

C C
Deaera

Plants at

DISTRIC

is expanding

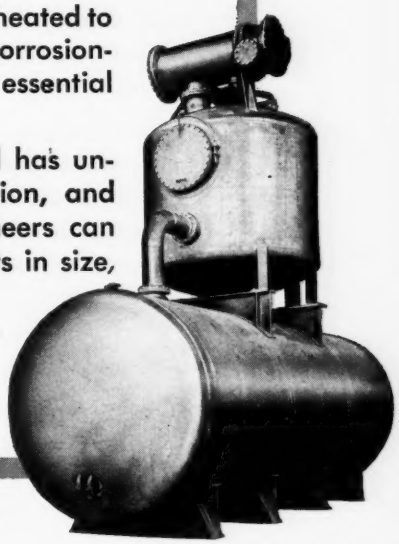
Elliott deaerating heaters go along with new power units

If you want to spot the areas of industrial expansion, watch the new power plants going up. Or, since practically all modern power plants use feedwater deaeration, note the many Elliott deaerating feedwater heaters which first appear high up on each building's framework—symbol of modern economical power generation. The illustrations opposite show a few of many installations in the south, where power generation is keeping pace with industry's growth.

Elliott deaerating heaters furnish feedwater heated to saturated steam temperature while removing corrosion-causing oxygen and dissolved gases. Two essential services in one package.

Elliott Company pioneered deaeration and has unrivalled experience in the design, construction, and application of deaerating units. Elliott engineers can fit the deaerating heater to your requirements in size, capacity, and operating conditions. They can often help with your heat balance problems.

Do you have Bulletin N-15 — "Deaeration by Elliott"?



Shop view of a 600,000-lb-per-hr unit, typical of a number now in service in various southern plants.

N-991

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Fig. 2698 —Globe, inside screw, 600 lb sp.

Fig. 2699 —Angle, inside screw, 600 lb sp.

Similar design, O.S. & Y. type, also carried in stock.

For design and dimensional details on these and other Edward steel valves, write for Catalog No. 103.

These Features Save you Money!

1. Low Pressure Drop — You can use smaller pipe sizes.
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